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THE SOCIETY OF ARTS MOTOR TRIALS.

AT the meeting of the Society of Arts on Wednesday the 20th inst., under the presidency of the Duke of Abercorn, C.B., a paper on the "Objects and Methods of the Society's late Motor Trials" was read by Prof. A. B. W. Kennedy, F.R.S.

If the essence of science may be rightly summed up in the one word "measurement," the work which he and his colleagues, Dr. Hopkinson and Mr. Beauchamp Tower, carried out last September was as thoroughly scientific as any work could be, for it consisted in making a detailed series of measurements of quantities of gas, water, coal, heat, work, temperature, &c., extending over many days, and including some 5,000 observations or more. The report already published gave a kind of concentrated essence of these measurements, but the Council of the Society considered that it would be desirable to present a further statement, that would be useful and intelligible to lay as well as professional members. This proved to be a more difficult task than was expected so to steer a course safely between the tempting Scylla of sacrificing everything to making the paper popular by taking for granted the complete technical ignorance of his audience, and the still more fascinating Charybdis of making the paper entirely technical, by assuming that all his hearers were trained engineers.

Under the conditions of entry the motors were to be suited for electric lighting. This involved running at a fairly high speed, and the utmost regularity in so doing. This regularity formed one of the points into which the judges had to examine most carefully, but the general characteristics of the motors offered more grounds for investigation than their special adaptation for driving dynamos. The power they exerted had to be measured, also the proportion of this available for work, as well as the cost in fuel, lubricant, and water, of producing the power. All these were capable of accurate measurement, but some other points of equal importance, *e.g.*, whether the bearings were sufficient in surface, whether the mechanical construction would stand the wear and tear of continuous working, or that the ignition arrangements could be depended upon, could not be determined by direct measurement. However, the judges in the cases before them were unanimous in their conclusion that there was no reason to doubt the capability of the engines working well in ordinary use after behaving satisfactorily during trial.

Now, as to the quantities actually measured, and the leading ideas which governed the choice and nature of the measurements made. A chemical analysis, as most people may know, is seldom carried out quantitatively to the end. Some of the constituents of the material are directly determined, while the remainder is put down "by difference," meaning that the nature of the quantity in question is inferred only. Now the aim of the tests made by the judges was to measure this difference, or to reduce it to "next to nothing," and even then to watch it with suspicious eyes until it disappeared into nothingness. Perhaps, however, this case is more analogous to that of the accountant than the chemist, for if the performance of a heat engine of any kind be stated in the form of an account, the two sides *must* balance. The distinguished French engineer and experimentalist, M. Hirn, originated this idea.

An account for an engine might be made thus :—

	Th. U.		Th. U.
Heat which should have been received, viz., total heat of the combustion of the fuel used	100	Heat turned into work	10
		Heat either not received or rejected, by *difference*	90
Total	100	Total	100

Both sides agree, but the result is about as unsatisfactory as it would be if the numbers represented pounds sterling, and the £90 were a trifling discrepancy in a cash balance. This waste may be unavoidable, and no more than £10 out of the £100 could be utilised. Still one would like to know, first of all, how much of the £100 went in lender's commission, paid in advance, or, analogously, how much of the 100 thermal units was never received. It may hardly be believed that there are people to whom the idea of accounting for the unused balance of heat in an engine still appears an absurd folly, an entirely uncalled for and useless display of what they are pleased to call "theory." It is needless to argue with such people, but it may be remarked that the first step towards recovering a past loss, or avoiding a future one, is surely and certainly to find out how and when and where the loss occurred. It may prove that what seems to have been waste was really legitimate working expenses, and the 10 per cent. utilised as high a profit as one could expect to make. For it is to be pointed out that the whole heat is no more available for turning into work, than the whole receipts of a railway are available for dividend, and this, in spite of friends who advocate some slightly disguised form of perpetual motion, neglectful of the facts that energy is always being transformed from a higher to a lower form, and that the direct change back again without further expenditure of energy is an impossible one.

Now, first as to the credit side of the heat accounts, or to the determination of the whole heat which ought to have been received by each of the engines. In the case of gas engines this was comparatively simple. The quantity of gas used was measured through standard wet-meters, lent by Messrs. Wright and Son; they were most carefully adjusted before each test, and their errors (if any) may be taken as negligible. The calorific value of the gas had next to be determined by chemical analysis, that is to say, the several samples of gas collected through the meter during each trial were mixed, and analyses made of the mixture. The heating power of the gas was arrived at by calculation from the results of the analyses, and the calculated heating power of the gas may safely be accepted as the true measure of its value. It was noticed that the gas on different days varied in value, for instance, 1 cubic foot of gas on September 19th gave 626 thermal units, on the 21st it was 633, while on the 27th it was 624 thermal units. Given the gas value along with the atmospheric pressure, meter pressure, and temperature of the day with the number of explosions in the cylinder during the trial, it is easy to find the heat that ought to be received by the engine, and this figure constitutes the credit side of the account. To get at the number of explosions it was necessary to count every miss throughout the trial, an extremely tedious operation to those immediately concerned.

On the debtor side of the account there is first a certain amount of heat turned into work; secondly, a larger item spent in heating the water which passes through the jacket round the cylinder; thirdly, another large loss rejected with the discharged gases up the waste pipe; and lastly, some small amount lost by radiation. The determination of the work done was taken from the average of 24 indicator diagrams, made at intervals of a quarter of an hour during the six hours' run, and may be reckoned as fairly accurate. It was easy to ascertain the amount of heat carried away by the water jacket. The water was run to waste on leaving the jacket; its inlet and outlet temperatures were frequently measured; and the quantity of water was tested by a corrected water meter. An unexpected result was, that there was no apparent economic difference between the use of a largish amount of circulating water with a rise of temperature of about 46°, and the use of a smaller quantity with more than double that rise.

The remainder of the whole heat unaccounted for, of which nearly all is what has been called "exhaust waste," the judges attempted to determine by calculation from the indicator diagrams, instead of merely putting it down as a "difference." Although these calculations could only be approximate, they afforded very important practical information. If, for instance, the calculated exhaust waste be greatly below the actual exhaust waste by difference, it can only be because the whole heat of combustion has never been received.

This "commission" has been deducted from the left hand side of the account, and prevents the account balancing. In practice it has been possible to effect a saving of 20 per cent., while without the calculation the very existence of the loss would have been unknown. Assuming that the initial temperature of a charge in the cylinder is the same as that of the outgoing jacket water, the ratio of gas to air can be calculated, and the calculations of the temperatures at all the other principal points in the cycle are simple. Part of the total calculated heat which the charge had to give up at the end of the expansion, is taken up by the jacket water as the heated gases are driven out of the cylinder, and has already been accounted for in the water jacket waste. Adding together the heat turned into work, the heat rejected by the jacket water, and the heat rejected in exhaust gases, the amount should somewhat exceed the whole heat received (because part of the quantity has been measured twice over). In the Crossley engine this over balance was actually found. In the Atkinson nearly 10 per cent. was unaccounted for until, by reference to the expansion curves, it was found that the combustion of a charge was incomplete when the return stroke commenced. A similar examination of a Crossley engine expansion curve shows it to have been losing heat at end of stroke. The Griffin engine on the other hand holds an intermediate position.

The heat balance for a steam engine and boiler differs only in its details. Taking the boiler first, on the credit side there will be the calorific value of the coal found by analysis and calculation, which agreed within 1 per cent. with the experimental value, and was about 72·5 per cent., weight for weight, of the value of the gas consumed in the gas engine trials. So far as the boiler is concerned, none of this heat is expended in doing work; the useful portion of it is spent in heating and evaporating water only. Besides this, heat is expended in raising the temperature of the furnace gases and of surrounding objects by radiation, also evaporating moisture, if any, in the coal. There is also here a possibility of imperfect combustion of some of the coal forming carbonic oxide instead of carbonic acid. The heat expended usefully in evaporation can be accurately measured; but the determination of the heat lost in the escaping gases is not so simple, there being no direct method of finding the temperature. Samples of the chimney gases were taken and submitted to analysis; the specific heat of the gases can be readily found, and therefore the quantity of heat carried off by them computed. The analysis also allows a calculation of the loss incurred by the incomplete combustion of the carbon. To estimate the loss by radiation, the best approximation may be obtained by measuring the quantity of coal consumed, during some hours, in keeping up a given steam pressure in the boiler, and an experiment of this nature was used in testing the Paxman engine. Owing to the want of means for measuring the exhaust steam from a non-condensing engine when it is utilised in causing a draught in the chimney, the heat account for the steam engine itself, apart from its boiler, had to be unbalanced. The amount utilised was 12·3 per cent., the remaining 87·7 per cent. being only the "difference." By using the exhaust steam to heat the feed water, some 15 per cent. of the rejected heat can be usefully employed.

Having measured the indicated horse-powers and found the thermal efficiency of the engines by comparison with the total heat received, the mechanical efficiency or ratio of useful work done to the total indicated work was next considered. To find the actual mechanical output, an absorption dynamometer was fixed to the flywheel of the engine under test, and the readings were taken every five minutes, therefore the average value should be closer to truth than that for the indicated horse-power averaged from the readings taken every 15 minutes.

Now, the regularity of working is an important point to be considered, which was mentioned at the beginning of this paper. The resistance of a dynamo to being turned may be looked upon as a practically uniform and constant resistance to the rotation of the engine crank shaft. In an ordinary engine changes of speed, during a rotation of the crank shaft, are unavoidable; all a manufacturer can do is to reduce those changes to the lowest limit of variation. The Paxman engine, having cranks at right angles, maintains a fairly uniform effort, even without a flywheel. The Atkinson engine, at full load, receives an impulse on its shaft at every revolution. The Crossley having only one impulse for every two strokes, was furnished with countershafting, whereby some considerable power was lost. The Griffin engine has only one cylinder, working at both ends, and gives an equivalent to two strokes every three revolutions.

It will have been noticed by those who heard the paper read that an endeavour has been made throughout to avoid all direct comparison between the different motors in points which could in any degree be matters of argument. The paper has thereby, no doubt, been deprived of some piquancy, and, perhaps, of some scientific value. The motor *trials* have been taken as the subject, and not the motors themselves, and it is to be hoped that the discussion to follow will keep to the same lines. It should also be put on record that the duties of the Motor Committee of the Society were by no means formal, but that by their action and advice its members had a very great deal to do with the ultimate success of the trials, although they wisely left the judges an entirely free hand in the executive part of the work.

A vote of thanks being given to Prof. Kennedy for his paper, it was decided that the discussion thereon should be taken on the 27th inst. The medals were then distributed to the competitors, and the meeting adjourned.

THE letter which we publish in to-day's issue relative to lead covered conductors is very concise and to the point. The writer agrees generally with the remarks we have already made, and gives additional information besides. We are rather surprised that the manufacturers of these leads have as yet exhibited no inclination to controvert the statements of Prof. George Forbes which, to say the least, were damaging to their interests. Given good construction and a suitable soil for their resting place, lead covered wires are practically indestructible, but on this we shall have yet more to say in our next.

MR. LEWIS, the General Manager of the Western Counties and South Wales Telephone Company, has just succeeded in spanning the entrance to Dartmouth Harbour, the distance from pole to pole being 800 yards, which is, we believe, the longest span in England. Mr. Lewis determined to go out of the usual course and to try a very fine light wire which has already successfully withstood the effects of two severe gales. The weight of the wire, No. 17 silicium bronze, between supports is only 24 lbs., and the strain 58 lbs. Mr. Lewis's abilities would, we think, be invaluable in a telephonic service nearer home, for he is untiring in his efforts to achieve success in every way.

THE Series Electric Traction Syndicate is we feel sure an enterprising body and will not confine its operations to the working of tramcars on the Short-Nesmith system. Such being the case we venture to commend to the notice of the directors the moribund Elieson Company's position, in the hope that they may see their way to take over the running powers on the Stratford-Manor Park line. If any doubts exist in the minds of the directorate as to the possibility of successful working with accumulators the record of work done will effectually banish it, and they have only to glance through the report of Prof. John Perry to ascertain that it can be accomplished at a cost considerably less than is the case with horsed cars.

JUDGE WEATHERBE has probably by this time altered one of his views on submarine cables to a very material extent. The information which Mr. Kennelly has given upon the subject of iron sheathing and its influence upon the speed of signalling is of such a nature that even the worthy judge himself can only, on appeal from us, reverse his former decision. Now that our argument on this point has received such strong support, we hope that our correspondent will see that practical experience *is* necessary to enable one to pass a verdict upon such an important topic as that under discussion. Only those who have spent many years of their lives in submarine cable manufacture, laying and working, are competent to assert that all the necessary evidence has been laid before them which will enable a correct conclusion to be arrived at upon the numerous points involved in the study of submarine telegraphy.

THE ELECTRIC LIGHT AND THE PARIS EXHIBITION.

ALTHOUGH it is more than a month yet before the opening of the Paris Exhibition, the whole of the arrangements for its illumination by electricity are in a most forward state, and most stupendous they are in conception. The agreements between the Ministry of Commerce and the International Syndicate of Electricians have been satisfactorily settled, and all now promises most favourably for an enormous success and the most perfect exposition of electrical illumination the world has yet seen. For the main portion of the details which follow we beg to acknowledge our indebtedness to a lecture just delivered before the International Society of Electricians by M. Hippolyte Fontaine.

M. Fontaine began by tracing the history of previous exhibitions open at night, and he truly said that exhibitions only open during the day were semi-private, and neglected one of the most important branches of industry and the economic arts, and did not merit the name of universal. The exhibition of the centenary of 1789 could not be closed at night, and it was determined to adopt the electric light. The difficulty which then presented itself was to make that accord with the decision arrived at by the Administration, to be at no expense for that lighting. Everything else was paid for--water, gas, steam, all except electricity. "That," said M. Fontaine, "is wholly unjust, and I protest energetically, in the name of every electrician, against the unceremonious manner in which we are treated. It is even said that electricians are too happy to show the mode of lighting they extol, and that at the commencement of an industry sacrifices must always be made to make it known. There is, to-day, about a million horse-power used in producing the electric light, which corresponds to a total intensity of about 200,000,000 of normal candles. If that does not suffice to demonstrate that electric lighting is wholly practical, it is to the despair of the most intrepid innovators."

The honour of this great project for the electric lighting of the exhibition belongs to M. Georges Berger, who will be remembered for the success of the evening opening of the Electrical Exhibition of 1881. As Honorary President of the International Society of Electricians, he invited the Syndical Chamber of Electrical Industries to submit to him a report on the subject; and M. P. Lemonnier, its acting president, and M. H. Fontaine, its honorary president, were charged with that duty. These gentlemen were convinced, in the first place, that it was impossible to extend the lighting through the immense range of the exhibition, and that it was necessary to restrict it to the gardens of the Champ de Mars, to the machinery department, and a few other portions. The question of remuneration was solved afterwards by the Minister, who decided to confide the care of this lighting to a syndicate, presided over by MM. H. Fontaine and Lemonnier, and open to the whole of the electricians throughout the world, by abandoning half the evening receipts and a part of the price of the subscription cards. Despite this, the negotiations with the State were long and tedious. The matter, after outcries of "monopoly" and other drawbacks, came to the Council of State. At last the Minister gained the day, and was authorised to accord "to a group of electricians the right of making a collective exhibition in the machinery department and the gardens of the Champ de Mars, and to receive from the evening visitors an admission fee, on condition of paying the State a part of the receipts."

The electricians' syndicate was approved, and M. de Bovet was appointed director; M. Picou, the well-known electrical engineer, was chosen engineer-in-chief, and MM. Dumont and D. Napoli and A. Révérend inspectors of works. M. Fontaine afterwards remarked very justly that in speaking of the electric lighting of the Universal Exhibition of 1889, that, unfortunately, would not indicate that all the different parts of it would be open at night. In reality, with the exception of 4,000 or 5,000 exhibitors grouped in the machinery department, the 30,000 or 35,000 others spread about in the galleries of the various divisions will not participate in this favour on account of the reasons already mentioned. In addition to this, those private exhibitions in the gardens, of the Trocadéro, of the Esplanade of the Invalides, which wish to show their products in the evening, have been reduced to providing their own lighting. After this digression, the lecturer set forth the arrangements made for the lighting of the open portions of the exhibition very fully, which we reproduce *in extenso*.

COVERED SPACES.

We enter first into the machinery department, a vast iron building, whose harmonious and bold proportions excite general admiration. The lighting of this building constitutes the finest part of our programme; the project has been confided to the President of the Syndicate, and special care has been shown in the choice and division of the *foyers* which will figure therein. The building, properly speaking, consists (1) of a nave 383 mètres long, 114 mètres wide, 45 mètres high at the longitudinal axis, and has 43,662 square mètres of surface; (2) of a gallery on the ground floor 18 mètres in width running all round the periphery, and encircling, so to speak, the nave, presenting a total floor surface of 16,675 square metres and a ceiling height of 8 mètres; (3) of a gallery on the first floor entirely covering the preceding, and having, consequently, the same floor surface. The total floor surface of the machinery department is therefore approximately 77,000 square mètres—nearly 8 hectares. The lighting of the nave will be obtained by means of two series of independent apparatus, and working sometimes separately, sometimes simultaneously. The first series is formed of four lustres each containing 12 regulators of 60 ampères burning the naked light. These lustres are placed nearly equidistant, in the longitudinal axis of the building, at a height of 40 mètres. They will be worked by means of windlasses fixed on the girders of the framework at the height of the first floor. The carbons, specially made by M. Lacombe, will be 0.025 m. in diameter. The regulators will be disposed in crowns and maintained in an iron circle 3 mètres in diameter, so that the arcs will be about 0.80 m. apart. These four lustres, which will be sufficient in themselves to assure the proper lighting of the nave, will be installed, fed, and kept in repair by the Gramme Company. The regulators are disposed in series of three; their network will therefore be composed of 16 circuits of 60 ampères under 200 volts difference of potential. The second series will be composed of 86 regulators of 25 ampères, placed at 15 mètres from the ground, on five longitudinal ranks and 18 transverse ranks. There will be one regulator to about 400 square mètres of floor. These 86 regulators will be furnished with clear globes 0.45 m. in diameter. Their working will be assured, either by counterpoise suspensions, or by windlasses placed, as in the case of the lustres, on the girders of the building at the height of the first floor. The carbons, of various manufacture, will have a uniform diameter of 14 millimetres. The carbon replacing will be done on the ground floor. The suspension points of the 86 regulators have been chosen in such a way that the apparatus, when it comes down, shall be in one of the passages of the nave between two rows of exhibitors. The regulators of the 25 ampères have been divided among eight members of the syndicate, as follows:—

Crompton & Co. (England)	24
Ducommun, Steinlen & Co. (Alsace)	20
Sautter, Lemonnier & Co. (France)	12
M. Jaspar (Belgium)	11
Belgian Lighting and Electrical Transmission Company (Belgium)...	6
M. Borsat (France)	5
French Agricultural Material Company (France) ...	4
M. F. Henrion (France)	4

The sides of the ground floor and the galleries on the first floor will be lighted by means of 276 regulators of

8 ampères, placed 5 metres from the floor, either on posts or attached by cables to the ceiling. The installation and keeping up of these 276 regulators have been entrusted to the following electricians :—

Crompton & Co. (England)	79
Ducommun & Co. (Alsace)	76
Sautter, Lemonnier & Co. (France)	30
Alioth & Co. (Switzerland)	30
The Œrliken Works (Switzerland)	25
French Agricultural Material Company (France) ...	8
Belgian Lighting and Electrical Transmission Company (Belgium)...	8
M. F. Henrion (France)	8
M. Jaspar (Belgium)	7
M. Victor Popp (France)	5

The staircase situated in the longitudinal axis, on the Avenue de Suffren side, will be decorated by means of 360 8-candle incandescent lamps by the Jarriant Company (France). The opposite staircase, situated near the Avenue de la Bourdonnais, will be lighted by 160 8-candle incandescent lamps installed by Crompton & Co. The luminous intensity which this powerful lighting of the machinery gallery will develop will be such that M. Fontaine estimates that that produced alone by the four groups of 12 *foyers* of 60 ampères will give, at a mètre from the floor, a light of 12 carcels-mètre in the parts situated about 15 mètres from the *foyer*, and from 8 to 2 carcels-mètre thence to the pillars and angles of the nave. The whole of the electrical arrangements will therefore give a lighting power varying from 4 to 15 carcels-mètre. The railway class annexe occupies a large rectangle of 187.50 m. in length by 30.50 m. in width, or 5,187 square mètres of space ; the lighting, which is confided to M. Borsat, will comprise 5 regulators of 25 ampères and 30 regulators of 8 ampères. This annexe, which backs directly upon the machinery department without the interposition of partitions, will participate, moreover, to a certain extent, in the general lighting of the grand nave and sides of the building. The vestibule placed in front of the central staircase of the small axis of the building will have 10 regulators of 8 ampères and 320 10-candle incandescent lamps, the installations of which will be carried out by the Société des Forges et Chantiers de la Méditerranée. The lighting of the gallery of 30 mètres joining the vestibule to the Grand Dome has been handed over to the Cance Company, who will carry it out by means of 48 fixed luminous points of 8 ampères.

The magnificent dome, designed by M. Bouvard, will be brilliantly lighted. At the top, in the lower rise of the dome, the Gramme Company will place a crown of 48 incandescent lamps of 500-candle-power ; on the first floor, in the backing pavilions, the Clerc Patents Syndicate will instal 16 sun lamps ; under the archways of the angles various members of the syndicate will place 14 lustres of 20 incandescent lamps of 8-candle-power. On the façade, the Company for the Transmission of Power by Electricity will place 16 regulators of 8 ampères and 3 regulators of 16 ampères. In the connecting pavilions, the same company will suspend eight regulators of 8 ampères. Lastly, the staircases will be lighted by eight 500-candle incandescent lamps, and the gallery on the first floor by 10 of the same lamps installed by the Gramme Company.

The Rapp Gallery, which separates the Various Industries Gallery from the Fine Arts department, will be lighted by means of 3 lustres each formed of 6 regulators of 8 ampères, placed in the middle, and of 26 regulators of the same intensity placed along the longitudinal walls. The Desaix Gallery, which separates the galleries of the various groups from the liberal Fine Arts building, will be lighted similarly to the preceding by the Company for the Transmission of Power by Electricity. The building of the Administration used by the general direction of works, the Press pavilion, and the offices of the *Bulletin Officiel de l'Exposition* will be lighted by the Edison Continental Company by means of 400 8-candle incandescent lamps.

OPEN SPACES.

The open spaces to be lighted by electricity may be divided into five sections ; The interior courts and avenues, the upper garden, the central garden, the lower garden, the bridges and galleries bordering on the Seine.

1. *Interior Courts and Avenues.*—The motive-power court, in which will be placed the steam generators for the mechanical service and various private installations, will be lighted by 18 regulators of 8 ampères, installed by Messrs. Ducommun. The Suffren and Labourdonnais Courts, on each side of the palace, will be lighted by 16 regulators of 8 ampères by the same firm. The interior avenue of Labourdonnais, near the Fine Arts building, will have 7 regulators of 8 ampères. The Rapp entry will be particularly brilliant, as there will be 22 regulators of 8 ampères. The two latter installations will be carried out by the Edison Continental Company.

2. *Upper Garden.*—The lighting of the upper garden has been entrusted to the Company for the Transmission of Power by Electricity and the Company for the Electrical Working of Metals. The first named will instal 24 regulators of 8 ampères round the pavilions of the City of Paris, and 48 regulators of the same intensity under the restaurant galleries. The second company named will instal 850 4-candle incandescent lamps round the lawns and 100 8-candle incandescent lamps for the kiosques and orchestras.

3. *Central Garden.*—The lighting of the central garden will be effected by the Edison Company, the Electric Company, and the Electric Lighting Company. The two last named have but a small portion of this space to illuminate. The central garden may, therefore, be considered as belonging to the Edison Company. The Electric Company will light the façade of the Palace of Liberal Arts by means of 34 Gramme regulators of 8 ampères placed on two circuits of 17 arcs each. The Electric Lighting Company will instal 34 regulators of 8 ampères against the interior façade (garden side) of the Palace of Fine Arts, 22 regulators of 8 ampères in the walls, and 28 Jablochkoff candles at the entry of the staircases. The Edison Company will place 33 regulators of 8 ampères against the exterior façade (on the Avenue de Labourdonnais side) of the same building, 1,000 incandescent lamps about the garden, 100 8-candle lamps in the orchestra kiosques, 1,000 4-candle lamps on the walls and magnolias, and 300 incandescent lamps along the lawns surrounding the basins of the luminous fountains. This part of the project is due entirely to M. Alphand, who has wished to give these gardens a rich luminous decoration, and the Edison Company was well chosen to give every satisfaction to the great Paris engineer.

4. *Lower Garden.*—The lower garden will be exclusively lighted by the Electric Lighting Company, which proposes to use Jablochkoff candles, and several new systems of arc regulators. It will instal 60 *foyers* of 8 ampères in the alleys, and four regulators of 25 ampères to illuminate the waters of the fountains placed under the Eiffel Tower.

5. *Approaches of the Seine.*—It is again the Electric Lighting Company which is charged with this installation comprising :—25 *foyers* of 8 ampères in the agricultural annexes ; 10 on the Bridge of Jena ; 16 on the footbridge of the Bridge of Alma ; 31 along the cutting of the Decauville railway ; and 3 on the bridge facing the station.

MOTIVE POWER.

Now that the nature and importance of the electric *foyers* which the Syndicate is preparing are known, we will now give some details as to how they are to be maintained.

Central Stations.—On the Champ de Mars there will be six central stations built, as follows :—The Gramme station, the Edison station, the station of the Transmission of Power and the Working of Metals Companies, the Jablochkoff station, the Ducommun station, and the station of the Syndicate of Electricians.

The Gramme station is situated in the interior garden, between the machinery department and the miscellaneous industries galleries, its surface being 640 square mètres. It comprises two dynamos of 175 horse-power and three dynamos of 100 horse-power, all five of double action and working under 200 volts of difference of potential. The mechanical part of this section has been confided to Messrs. Davey, Paxman & Co., of Gloucester. The steam engines, nine in number, are of the locomotive type; the furnaces, placed below, will be charged automatically by M. Godillot's process. The machines of the Paxman system are triple expansion, one being capable of developing 350 horse-power, the second 250, and the third 100. The Gramme Company will therefore have 700 horse-power at its disposal.

The Edison station is situated near the Press pavilion, in the La Bourdonnais Avenue, and will occupy a surface of 400 square mètres. It will contain four Belleville boilers of 150 horse-power, four Weyher and Richmond steam engines of the same power, and four Edison dynamos of 100 horse-power with four other Edison dynamos of 50 horse-power.

The Jablochkoff station, installed by the Electric Lighting Company, is situated on the banks of the Seine, to the left of the Bridge of Jena; it occupies a surface of 400 mètres. Its total power will be 600 horses, obtained from four Terme and Deharle boilers and four Lecouteux and Garnier steam engines of 150 horse-power each. The electrical machines, numbering 19, will comprise eight alternating current Gramme machines, 10 Reychnewski continuous dynamos, and a Ferranti alternating current machine.

The station of the Transmission of Power and the Electric Working of Metals Companies is situated in the interior garden near the vestibule of the machinery department. It will contain two-coupled Corliss engines, together of 500 horse-power, supplied by multitubular boilers of the Roser system. Four Marcel Deprez double-linked dynamos will absorb this power, and will send the current to the various installations of these companies.

The Ducommun station is situated in the motive power court on the axis of the Champ de Mars. It is installed in the left wing of the building which Messrs. Steinlen & Co. are constructing to show their products. It will be of 300 horse-power; the generators will be of the Lagosse system, the engines made by the Ducommun firm, of the express Armington type, and the dynamos, 15 in number, of various powers.

The station of the Syndicate of Electricians is situated in the interior garden, between the Gramme and Transmission of Power Companies' stations, and occupies a space of 320 square mètres. It will have 400 horse-power; the boilers which supply it will be installed by Messrs. Lacroix, Terme and Deharle, Durenne, Montupet, Roser, Archambault, and Soucaille. A portion of the steam will be sent to the English section to work Messrs. Crompton & Co.'s machines. The machines which will be found in the Syndicate's station are:—A 100 horse-power steam engine and two of M. Borsat's dynamos; a 50 horse-power steam engine and a dynamo of the Société des Forges and Chantiers de la Méditerranée; a 30 horse-power steam engine and a dynamo of the French Agricultural Material Company; a movable steam engine with a Parsons steam turbine, exhibited by M. Carnot.

INSTALLATIONS IN THE MACHINERY DEPARTMENT.

Besides the six stations named above, which represent together a mechanical power of 3,100 horse-power (steam), the Syndicate will have in the machinery department a series of motors, of which the following are the principal:—

	H.P.
Gas motors lent by the Parisian Company for Lighting and Heating by Gas	150
Gas motors installed by the Otto Motor Company ...	250
Compressed air machine, installed by M. V. Popp ...	20
Steam engine installed by Sautter, Lemonnier & Co.	100
" " " Boulet & Co.	100
" " " the Œrliken Works ...	70
" " " Alioth & Co.	30
" " " the Farcot firm	80

When all these installations are finished the International Syndicate of Electricians will possess a mechanical force of about 4,000 horse-power, and, in addition, about 10,000 kilogrammes of accumulators to facilitate certain lighting services.

M. Fontaine then gave some details of the mechanism of the luminous fountains which are expected to prove so great an attraction to the exhibition. They will be divided into two groups as follows:—

1. *Mr. Galloway's Fountain.*—From the commencement it was decided to adopt fountains on the projection system, and as the exhibition was international, the help of Mr. Galloway (England), was asked. This gentleman was in possession of a system which had been proved at Manchester, London, Glasgow, and more recently at Barcelona. This fountain will be placed in the central garden between the Fine Arts and Liberal Arts buildings; it will be composed of the union in one group of powerful jets of 40 to 50 mètres in height. These jets will be lighted by hand regulators, of an intensity of 60 ampères and numbering 18, placed under a series of glasses forming the bottom of the basin; the carbons will be placed nearly horizontally; the bottom of the reflector is raised so as to permit the falling of the sparks which may become detached, and the carbons are so disposed that the positive one will present its face in the direction in which the light is to be utilised. Under these circumstances the apparatus sends vertically a parallel stream of light which traverses the glass and the shallow bed of water which covers it. The water circulating in this invisible luminous centre absorbs its light and presents itself to the eye as a brilliant crystal ray, as a golden dust, or as a quantity of small drops which can only be compared to precious stones. An ingenious mechanism permits of the regulation of the distance and of multiplying the effects produced. Between the regulator and the glass there can be placed a coloured glass, changeable at will, and the water jet will thus be successively white, red, ruby, blue, green, or yellow. In order to dispense with important machinery, M. Alphand has preferred to obtain the pressure and water necessary for the supply of this fountain by means of a conduit where the water will arrive with a head of 50 mètres.

2. *The Fountains of the Administration.*—M. Alphand conceived the idea of seeking for a new system and of a totally different nature. He came to the conclusion that he would have a single monumental fountain placed between the terrace of the upper garden and that of Mr. Galloway, and joined to the latter by a basin about 50 mètres in length. The principal subject will represent the ship of the City of Paris, surrounded with emblems, dolphins, dragons, marine animals, &c. The water will be obtained in the monumental part launched horizontally by the various animals, or coming from conches, vases, &c., and will be completed in the basin itself by a series of large vertical sheaves of varying shapes. This will all be lighted with electricity on the Galloway system for vertical jets. It appeared preferable, however, to M. Bechmann, who has studied the lighting of this fountain, to employ automatic regulators. These regulators will be disposed vertically, and furnished with a spherical mirror which will send a slightly divergent ray, and at a horizontal axis on a mirror plane inclined to 45°. This mirror will set the ray straight, and will again send it vertically to the glass forming the basin below the railing formed by the whole of the adjustments of the sheaves. For the horizontal jets the carrying out of the project presented difficulties; a luminous ray almost totally reflects itself and remains imprisoned in the column of water into which it is directed, but this total reflection disappears if the jet be broken; besides, it was impossible to adopt for these parabolic jets the system of the parallel ray of light employed for the vertical jets. After numerous trials, the following decision was come to: The water will be launched by an adjustment in the form of an elliptical crown giving a sheet of water of slight thickness, or, better, a stream of water empty in its centre. Through the centre of the adjustment will come the luminous ray, having its point of convergence at the orifice of the jet and diverging from this point; it will encounter the interior face of the liquid vein near the adjustment at

a point where the jet is not yet broken, and in which there will be produced a total reflection which will send its rays in the direction of the jet; this ray will continue to diverge, and will be sufficiently open to contain the lower part of the jet and to light it throughout its course. The electric lighting of these jets will be obtained by means of a regulator with a projector sending a luminous ray converging by the aid of a chimney on a reflecting mirror placed in front of the adjustment. This fountain, which is of an entirely new design, will have 30 jets—16 jets or vertical sheaves and 14 parabolic jets, which will be lighted by means of 30 regulators of 40 ampères. The electric currents will be supplied by the machines in the Gramme station.

We may remark in conclusion that M. Fontaine has promised the International Society of Electricians, after the Exhibition, to give it an account of the results obtained by this brilliant experiment in electric lighting.

NEW BRUSH FOR RAILWAY MOTORS.

THE Thomson-Houston Electric Company, which since it entered the field of electric railway construction has produced only apparatus of a superior quality, has recently made a great improvement in motor brushes by substituting for the copper brush one made of carbon.

The copper brushes heretofore used are of original design, patented, and allow the armature to rotate in either direction with perfect freedom, and are always maintained at an even pressure upon the commutator. They have always produced excellent results, but the experiment made with the carbon brush led to the belief that it possessed points of superiority over the copper, which supposition has since been found to be correct. The carbon brushes are now in general use on all the railways using the Thomson-Houston system.

Reports concerning the wearing of this brush and its effect upon the commutator have been received, which certainly speak very highly of its workings. On some of these roads there are many heavy curves and grades, and the motors are called upon to do unusually heavy work.

Reports regarding the brush say without exception that it is of longer life than the copper brush, and has a much better effect upon the commutator.

One report states: "The commutator is in good order, and the carbon has been worn less than $\frac{1}{32}$nd of an inch after running seven days of 16 hours each. I have another set which is doing equally as well." Another states: "I have not taken out any of the carbon brushes yet. They have been running for 19 days in two cars." A later report from the same place states: "I have one set of carbon brushes in car No. 1 27 days, and in that time the car made 557 round trips, and the brushes are good yet for several days. The commutator lasts longer with the carbon brush, and the carbon brush lasts longer than the copper one."

Another report says:—"On December 5th I put carbon brushes into motors on car No. 11. They ran well, causing no sparking at the commutators. They caused the commutator to present a very smooth, glazed surface, which was quite black. I used no oil or other lubricant. They ran eight days of eighteen hours each, and covered an approximate total of 700 miles." A later one from the same place states:—"On December 31st I put carbon brushes into the car Nay-Aug. These brushes worked well, and have the same effect upon the commutator as those on car No. 11. They were in use from the 3rd inst. to the 20th inst., 16 days, and making an approximate mileage of 703 miles."

Some of the latest reports state:—"We have had brushes in use 65 days, during which time the car covered a distance of 4,300 miles." "We have had brushes in use 43 days, during which time the car covered a distance of 2,900 miles."

Reports such as these cannot fail to prove the superiority of this brush.

The following is quoted from a letter written by Mr. W. S. Wales, President of the Third Ward Railway Company, Syracuse, N.Y.:—"We have given a trial of both the copper and carbon brushes, and are now using exclusively the carbons, as we consider them much more satisfactory, serviceable, and economical, preventing a large wear on the commutators."

Necessarily in a complete system all the small details must be worked out with care and attention. The commutator and brushes of an electric motor are vital parts, and too much cannot be said in praise of any appliance which will reduce the wear between them. The carbon brush is not an experiment. It has proved beyond question that it is superior to any brush in use on any system now in operation. These brushes are *only* used in connection with Thomson-Houston apparatus. Their use is covered by *letters patent*, which patents are owned by the Thomson-Houston Electric Company.

THE TRANSMISSION OF POWER BY ELECTRICITY.*

By FRANK J. SPRAGUE.

(*Continued from page* 328.)

Those who have followed with any particular interest the progress of the development of the transmission of power by electricity must be more or less familiar with the early experiments of Deprez and the papers by Prof. Lodge and Mr. Gisbert Kapp. The experiments of Deprez have not had that practical result which had been hoped for them, and it seems to me as if an attempt had been made to go further than commercial demands warrant. We must avoid the consideration of the subject from a purely theoretical light. *No system of transmitted energy can be made profitable unless the cost of the same at the far end, including not only the actual cost of production but the capitalised value of the possibility of accident due to the fact that the prime source of energy is not under immediate control, shall be less for the transmitted energy than the price that would have to be paid for its production there by water, steam, or some other agency.* As attractive as the use of water power appears as a prime source of energy, its uses are very limited, and every year will become more and more so; and unquestionably the great future of the transmission of power by electricity will depend upon the fact that in a large proportion of cases it will be cheaper to carry energy in the shape of electricity on a wire by the shortest cut between two points than to pack it up in the shape of wood or coal on the back of a mule or behind a horse. I have no sympathy with the theoretically possible, but really impracticable consideration of the transmission of power from Niagara to New York; for Niagara has a far greater value as a sublime spectacle than as a commercial factor in metropolitan affairs. I will then in my estimates confine myself to that which is practical and possible, and will consider the conditions under which power shall be so transmitted. Messrs. Lodge and Kapp have deduced some very interesting formulæ, but one of the conditions which was taken into account by them was that of leakage. In a purely theoretical study this is as it should be; but the transmission of power by electricity to meet the demands of actual life must above all things be reliable; and by this I mean, not merely certain to supply power at the end of the line, but to deliver a definite percentage under perfect regulation and a known cost. This cannot be done with the uncertain and variable element of an unknown but material leakage; for if this leakage exists, then it must be a variable quantity depending not only upon the condition of weather but likewise upon the continual variation which exists in the electromotive force when the load is not constant. We meet then with the condition that in the successful installation of a plant for the transmission of power, we must be free from material leakage; that is, the leakage must be so small under all possible conditions of service as to never interfere with the efficiency and reliability of the transmission. Hence in the formula which I in practice adopt to determine the elements of my work, I shall assume a line of practically perfect insulation. I am justified in this because the additional expense to secure this desirable result is more than compensated for by the reliability of the service. We can only accomplish this by the most careful line erection and choice of insulators. It can be materially aided by running the positive and negative leads each on an independent line of poles and perfectly clear of all trees, and of course a well covered wire can be used. When a double line of poles is used, it is advisable to wrap the lower ends with bare wire for a distance of about 6 feet above the ground, and to connect these bases together; or, if the poles are close together, a galvanised iron or copper wire should be taken around each pole at the distance given and joined together. This is to avoid the possibility of a serious shock in wet weather, which might be received by a person leaning against a wet pole, if any accident should occur to the line insulators when very high potentials are used.

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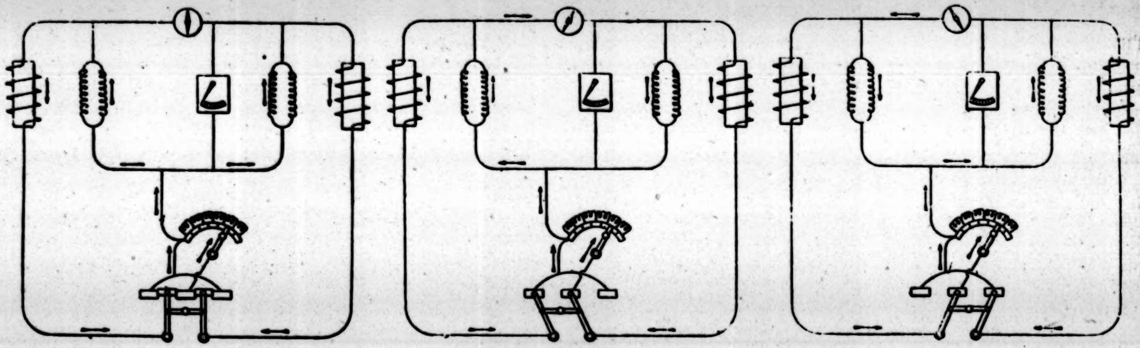
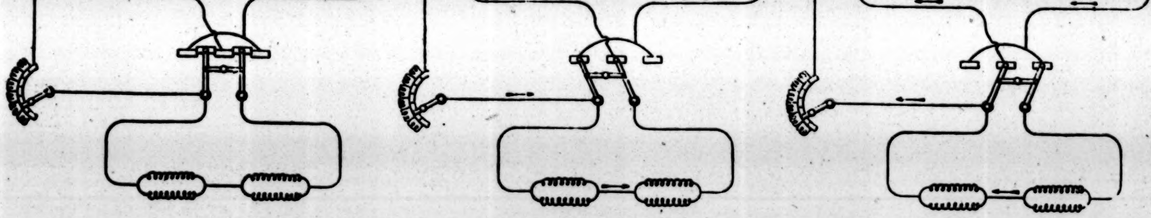
* A Lecture delivered before the Franklin Institute, November 12th, 1888.



First Diagram—Shunt Machines.



Second Diagram—Series Machines.

In the formulæ which are given, I shall make use of the term "couple efficiency." As long ago as the spring of 1888, Drs. John and Edward Hopkinson made tests of efficiency of double conversion with the Edison-Hopkinson and Manchester dynamos, the efficiency of the former rising at times to over 87 per cent., and of the latter to nearly 78 per cent. No others have made so thorough an analysis of the action of dynamo-electric machinery, and my own experience warrants me in assuming, for the purpose of this paper, a commercial efficiency of double conversion, where two machines are connected by a metallic circuit of no appreciable resistance, or what I have called the "couple efficiency," of not less than 80 per cent., which is only allowing about 90 per cent. commercial efficiency for the dynamos and motors. It will oftentimes rise higher than this, but I think it advisable in a specific formula to adopt a perfectly safe figure. This couple efficiency for either single, shunt, or series machines, or nests of machines, is easily determined with considerable accuracy and small expenditure of power. The method I prefer was one independently proposed but similar to that first put into practice by Dr. John Hopkinson, that English scientific investigator to whom we all owe so much. It may be termed the variable differential method; and depends upon the use of an electro-mechanical couple. The first diagram illustrates the testing of two shunt-wound machines. Two such machines are belted to a common line of countershafting having three pulleys, each being given its proper speed. To the third pulley is connected a motor of about one-third the capacity of one of the machines to be tested, this motor being one of a perfectly well known commercial efficiency, and provided with means for varying its speed; or, if desired, the power can be transmitted through a good dynamometer. The like terminals of the large motors are then connected together, an ampèremeter put into this circuit, and a potential galvanometer connected across the terminals. One terminal of each field is likewise connected to its proper line, and the other terminals of these fields are brought to the movable levers of a two-way circuit changing switch. One contact is carried to the main line, and between it and the other two is inserted a variable resistance, which in the middle position of the switch is short circuited. We have, then, the two large motors connected in an electro-mechanical couple, and to the same shafting is connected a third motor. The main dynamo being started, the switch set in the middle position, the motor is speeded up, which sets the countershafting in operation, and drives both the machines as dynamos, each exciting its own field. If the machines are symmetrical, no current whatsoever will pass over the branch connecting the two; they are simply in the position of two dynamos in parallel circuit with each other, with no external circuit and no path over which the current can flow except that through their field magnets; consequently very little power, save that of friction, is taken. The switch being moved in one direction, the resistance is thrown into the field of one machine. The electromotive force which it develops at this particular speed is now reduced; it becomes a motor, and current will flow over the connecting mains from the other machine, which is still a dynamo, which current is roughly expressed by the quotient of the difference of the electromotive forces of the two machines, divided by the resistance of the circuit. By varying the resistance in the fields this current can be made of any value up to the limit. We have here, then, one machine acting as a motor, and driving on to the counter-shafting with a certain number of horse-power, this counter-shafting driving the other machine as a dynamo with a certain greater amount of horse-power, this second machine furnishing the current which operates the first as a motor. The deficit, or loss of efficiency between the two machines and the friction is supplied by the third. By reversing the switch the resistance is first cut out of one field, and then thrown into the field of the other machine. This machine now becomes a motor, and the other machine becomes a dynamo. This reversal is not instantaneous, because it takes time for the field magnets to charge and discharge. The ampèremeter will drop to zero, and will then rise again progressively.

This method of testing can be used for two purposes, one for testing the actual horse-power developed and the couple efficiency, which can be done by measuring the current, the electromotive force between the machines and the horse-power delivered to the shafting by the third motor, and for the other purpose of testing simply the heating capacity of the armature coils with a given number of ampères. For this latter purpose it does not matter practically whether the machines are run at their normal speed and generate their normal electromotive force, or whether some lower electromotive force is used. If a lower electromotive force is present, it simply means that there must be a greater ratio of difference between the field magnet strengths and a larger resistance used with the reversing switch.

When desiring to test the two series machines, the connections are somewhat different, and are illustrated in the second diagram; the machines, of course, being mechanically connected as in the first instance. We can similarly test a multiple unit series system; and in all these cases, by the introduction of an artificial resistance into line, we can produce all the phenomena of an actual long-distance transmission. This method of testing, where there can be an immediate variable and controllable reversibility of the dynamo and motor, and test of the efficiency of transmission under widely varying conditions, illustrates in one of the most beautiful ways the flexibility and utility of electric transmission.

Assuming then, that we have no leakage, and that our dynamos and motors have a definite known efficiency, we will take up the consideration of a few formulæ.

Let l = distance between the generating and receiving stations in feet, plus the sag.
n = number of effective horse-power to be delivered on the motor shaft.
E = electromotive force at the terminals of the motor.
v = number of volts fall of potential on the line.
$E + v$, or E', being, of course, the electromotive force at the beginning of the line or the terminals of the generator.
a = efficiency of the motor.
CM = circular mils of conductor.

An electrical horse-power is 746 watts, watts being the product of current by electromotive force. Then for any horse-power, n, a motor efficiency of a and an E.M.F. of E at the motor terminals, we have the number of ampères equal to—

$$\frac{746\,n}{E\,a} \qquad (1)$$

Allowing m ohms as the resistance per mil-foot of copper, the total line resistance would be

$$\frac{2\,m\,l}{CM}$$

for a complete metallic circuit. From the above we have for the drop or fall of potential on the line.

$$v = \frac{746\,n}{E\,a} \times \frac{2\,m\,l}{CM} = \frac{1{,}492\,n\,m\,l}{E\,a\,CM}$$

or

$$CM = \frac{1.492\,n\,m\,l}{E\,v\,a}, \qquad (2)$$

Substituting for m its approximate value 10·5,

$$CM = \frac{15{,}666\,n\,l}{E\,v\,a}$$

Let me give a practical illustration. Suppose we have a motor, the efficiency of which is 90 per cent. at 400 volts electromotive force and when developing 10 horse-power, and that we wish to transmit this 10 horse-power 5,000 feet from a station and elect to lose about 9 per cent. on the line.

Our initial electromotive force will be 440 volts, and we would have

$$CM = \frac{15{,}666 \times 10 \times 5{,}000}{400 \times 40 \times \cdot 90} = 54{,}396$$

which is about equal to a No. 4 B.W.G.

Again, suppose we wish to transmit 5 horse-power over a distance of one mile on a complete metallic circuit of 45,000 cm., allowing 5 per cent. increase of length for sag, and no leakage. Suppose further, that the initial line potential be 300 volts, and that we wish to have 250 volts at the motor terminals, it is required to find the commercial efficiency which the motor must have.

Transposing our formula we have

$$a = \frac{15{,}666\,n\,l}{E\,v\,CM}$$

and substituting

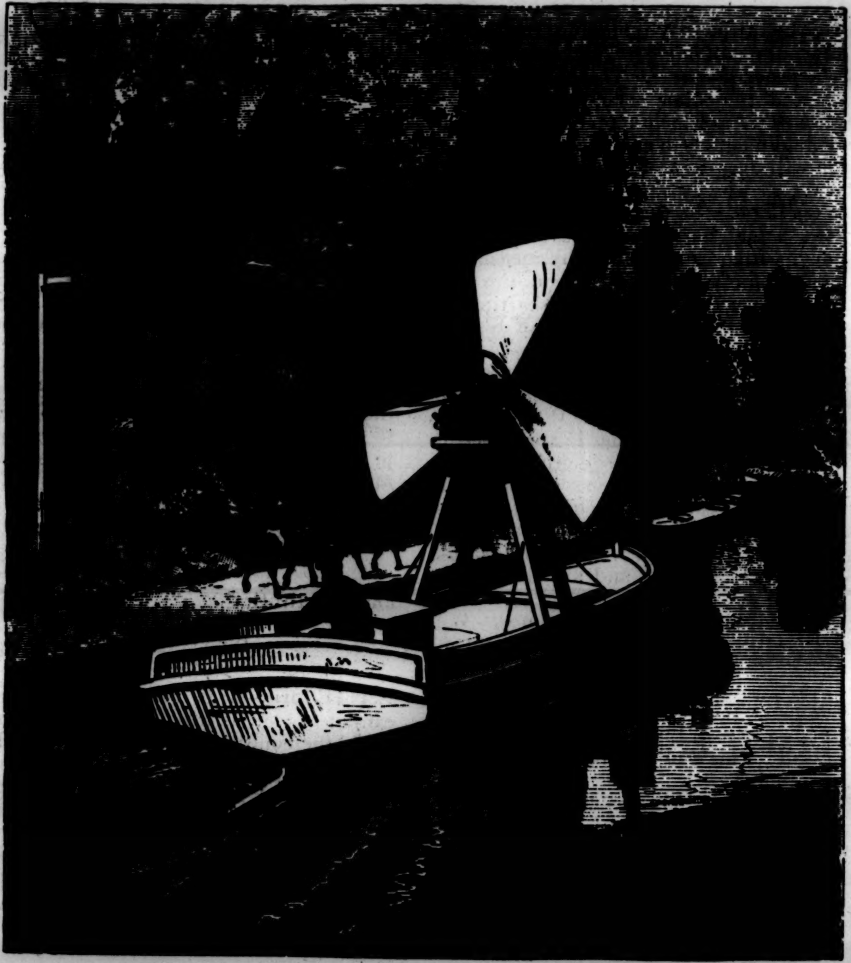
$$a = \frac{15{,}666 \times 5 \times 5{,}544}{250 \times 50 \times 45{,}000}\ 76 \text{ per cent.}$$

This formula is useful in determining what we cannot as well as what we can do. For example, if we made the condition 10 horse-power, all others remaining the same, the commercial efficiency of the motor would have come out 152 per cent., a most excellent machine indeed, and yet it is precisely this absurd thing that people practically say they will do in many of the statements which are made in relation to this subject. No science admits of more easy determination of conditions by plain and simple laws, and none brooks less violation of them.

(*To be continued.*)

A SUGGESTION IN CANAL BOAT PROPULSION.

A PAPER which excited much attention was read at the last meeting of the British Association for the Advancement of Science by H. C. Vogt. It is published in full in the *Scientific American* Supplement, No. 670. It was devoted to the subject of the propulsion of ships by air propellers. In it Mr. Vogt gave the summary and results of some very remarkable trials in navigation executed at Copenhagen. A steam launch was fitted with a windmill with steel blades. It was carried on a frame above the deck, and formed an aerial propeller wheel. Steam machinery was provided for rotating this. With this as a propeller, it was proposed to drive the boat. At first sight the method would seem an extremely inefficient one as regards application of power to so unstable a medium as air. But when it is remembered that recent investigations of the marine propeller have established it as a true reaction engine, in which a large slip is not necessarily an accompaniment of inefficiency, it will appear clear that there is nothing wrong in the principle indicated by Mr. Vogt. An air propeller is a pure momentum or reaction machine. Practically, it was found that a twenty foot launch of five and one-half feet beam, with a propeller eight and one-half feet in diameter, could be driven at a speed of five knots per hour in calm weather, and against a fresh breeze at four knots. The engine producing this effect indicated one and one-half horse-power. For a single indicated horse-power the thrust of the propeller was 36·7 pounds, or about the same as that of a water propeller. It might be supposed that in a contrary wind this thrust would disappear, but, on the contrary, through 75 per cent. of the horizon the thrust was found to be augmented by the wind.



A SUGGESTION IN CANAL BOAT PROPULSION.

With a larger launch, having a displacement of five tons, a speed of over six knots an hour was obtained against the wind. In some of the trials canvas-covered wings were used, but were found inferior to the steel ones.

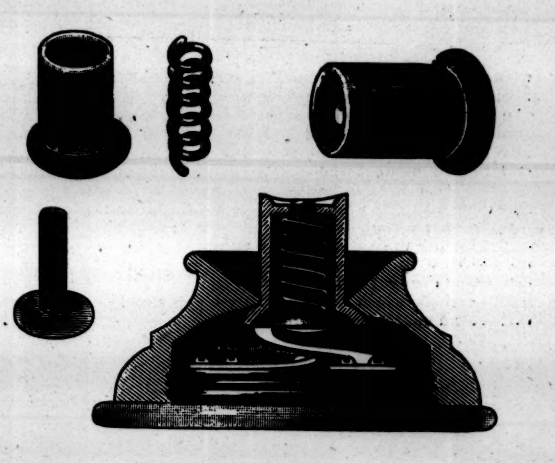
We illustrate in the cut accompanying this article a suggestion in the direction of canal boat propulsion. A barge is provided with one of these aerial propellers, carried well above the deck on standards. To actuate the propeller a dynamo is provided, which is carried on the top of the frame, and is connected by gearing with the propeller shaft. In this place frictional cone gearing might be advantageously adopted, so as to admit of a variation of speed. The blades of the propeller should be of steel accurately shaped and arranged to be turned at greater or less angles, according to the direction of the wind. To drive the dynamo, a lead of an electric circuit is carried along the bank, upon which line runs a trolly. Wires extend from the trolly to the dynamo, or the circuit may be completed through the earth, the body of water in the canal offering the best possible facilities for grounding the motor circuit. Thus equipped, a canal boat could make her way with a speed exceeding that generally used, and with no greater proportionate expenditure of power than that existing in all cases where the trolly system of actuating electric motors is in use.

The advantages of the system are obvious. The hull of the vessel would be entirely clear of machinery, and the entire weight of the propelling apparatus carried by the boat need not greatly exceed that of an ordinary tow rope. No disturbance of the water of the canal would be produced, except such as would be due to the progressive motion of the hull of the vessel. It would seem as though in this suggestion might be found a solution of the mechanical driving of canal boats; one that from the points of view of simplicity, non-occupancy of the hull of the boat, and minimum disturbance of the water, would be nearly perfect.

The air propeller works with an entire absence of vibration. It requires ten or twelve times the area of the corresponding water screw. The blades may for the first reason be carried out to the tips of increasing width. As the thrust is a perfectly quiet one, and if due to the motion derived from a dynamo would be free from the jarring inseparable from the motions of a heavy reciprocating engine, and as it is cushioned in all its motions by the high elasticity and mobility of the air, a very light frame would suffice to carry the wheel. The thrust of 75 to 150 lbs. would be all that the frame would have to resist—a thrust which would always be brought upon it gradually and would be gradually released. In steam canal boats a very considerable portion of the hull is occupied by the engine, boiler, and coal bunkers, while the constant eddies and currents produced by the propeller are destructive in their effects on the sides and bottom. This is all done away with in the aerial propulsion. The establishment of a line of poles and wire would not represent the tithe of the cost of a fixed or travelling towing cable.

THE DENIO FIRE ALARM.

WE illustrate herewith a simple automatic fire alarm combined with an ordinary electric push button, which is being manufactured by the Denio Fire Alarm Company, of Rochester, N.Y. The construction and operation of the device will be readily understood from the following description, reproduced from *Science*. In a thimble with an internal flange at one end, an external hollowed flange at the other, is placed a spring slightly longer than the thimble. This spring, one end of which bears against the internal flange, is compressed, and held in place by a pin which passes through it, the head of the pin fitting snugly in the recess made in the external flange of the thimble. The pin is sufficiently long to project entirely through the orifice in the internal flange end of the thimble. When the parts have been put together, the pin is secured in place by soldering to the flange, the solder used for this purpose being an alloy which will fuse at a low temperature, 150° to 160° F.



By removing the porcelain knob from any of the ordinary push buttons now in use, and substituting this thimble, the button is converted into an automatic fire alarm, without in any way interfering with its use as a call. Pressure upon the thimble causes electric contact between the springs in the base of the button fixture, in the usual manner, completing the circuit and ringing the bell.

As a fire alarm it operates as follows: When the heat of any room in which this attachment has been placed reaches a predetermined temperature, the alloy melts and releases the pin, which is forced out of the thimble by the expansion of the spring. The springs in the fixture are then brought into continuous contact by the pressure of the pin, the circuit is thereby closed, and the alarm transmitted to a central station, where measures can immediately be adopted for extinguishing the fire. The device is applicable to open or closed circuit, and to all purposes for which a thermostat is required. It is an efficient substitute for the more complicated and expensive thermostats, and should be very reliable, as the wires and connections are constantly being tested.

RECALESCENCE OF IRON.*

By J. HOPKINSON, F.R.S.

PROF. BARRETT has observed that if an iron wire be heated to a bright redness and then be allowed to cool, that this cooling does not go on continuously, but that after the wire has sunk to a very dull red it suddenly becomes brighter, and then continues to cool down. He surmised that the temperature at which this occurs is the temperature at which the iron ceases to be magnetisable. In repeating Prof. Barrett's experiments, I found no difficulty in obtaining the phenomenon with hard steel wire, but I failed to observe it in the case of soft iron wire, or in the case of manganese steel wire. It appeared to be of interest to determine the actual temperature at which the phenomenon occurred, and also the amount of heat which was liberated. Although other explanations of the phenomenon have been offered, there can never, I think, have been much doubt that it was due to the liberation of heat owing to some change in the material, and not due to any change in the conductivity or emissive power. My method of experiment was exceedingly simple. I took a cylinder of hard steel, 6·3 cm. long and 5·1 cm. diameter, cut a groove in it, and wrapped in the groove a copper wire insulated with asbestos. The cylinder was wrapped in a large number of coverings of asbestos paper to retard its cooling, the whole was then heated to a bright redness in a gas furnace, was taken from the furnace and allowed to cool in the open air, the resistance of the copper wire being from time to time observed. The result is plotted in the accompanying curve, in which the ordinates are the logarithms of the increments of resistance above the resistance at the temperature of the room, and the abscissæ are the times. If the specific heat of the material were constant, and the rate of loss of heat were proportional to the excess of temperature, the curve would be a straight line. It will be observed that below a certain point this is very nearly the case, but that there is a remarkable wave in the curve. The temperature was observed to be falling rapidly, then to be suddenly retarded, next to increase, then again to fall. The temperature reached in the first descent was 680° C. The temperature to which the iron subsequently ascends is 712° C. The temperature at which another sample of hard steel ceased to be magnetic, determined in the same way by the resistance of a copper coil, was found to be 690° C. This shows that within the limits of errors of observation the temperature of recalescence is that at which the material ceases to be magnetic. This curve gives the material for determining the quantity of heat liberated. The dotted lines in the curve show the continuation of the first and second parts of the curve, the horizontal distance between these approximately represents the time during which the material was giving out heat without fall of temperature. After the bend in the curve the temperature is falling at the rate of 0·21° C. per second. The distance between the two curves is 810 seconds. It follows that the heat liberated in recalescence of this sample is 173 times the heat liberated when the iron falls in temperature 1° C. With the same sample I have also observed an ascending curve of temperature. There is in this case no reduction of temperature at the point of recalescence, but there is a very substantial reduction in the rate at which the temperature rises.

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* Paper read before the Royal Society, Thursday, March 21st, 1889.

ELECTRICAL RESISTANCE OF IRON AT A HIGH TEMPERATURE.[*]

By J. HOPKINSON.

AUERBACH, Callendar, and I think also Tait, have observed that the temperature coefficient of electrical resistance of iron is abnormally high. So far as I know no one has pushed his observations to the temperature at which iron ceases to be magnetic.

The accompanying curve shows the results of experiments made upon a very soft iron wire. The abscissæ are the temperatures as estimated by the resistance of a copper wire, the ordinates represent the resistance of the iron wire having unit resistance at 20° C. It will be seen that the temperature coefficient of iron ranges from 0·0048 at the ordinary temperature to 0·018 at a temperature just short of 855° C., it then suddenly changes to about 0·0067. The last coefficient can only be regarded as a somewhat rough estimate.

This temperature is a higher temperature than I had observed previously in any case as the temperature at which a sample of iron ceases to be magnetic, it appeared desirable to ascertain whether the iron wire differed from other samples in this respect. A ring was formed of the wire, and was wound with a primary and secondary coil, and the resistance of the secondary was determined when the magnetisability of the iron disappeared. It was found that this resistance was the resistance which corresponded to a temperature of 870° C.; this temperature agrees with that at which the discontinuity in the resistance curve occurs within the limits of errors of observation.

ARC LAMPS AND THEIR MECHANISM.[†]

By PROF. SILVANUS P. THOMPSON, D.Sc., M.I.E.E.

(*Continued from page* 332.)

Passing to the *clutch-wheel* or *brake-wheel* type of lamps, we may remark that although so far back as 1861 Gramme attempted to construct on this plan a lamp (the existence of which was only published to the world in 1888 by M. Fontaine), this species of mechanism appears to be essentially British. The device of applying a clutch to a wheel in order to feed that wheel forward by degrees, the reciprocating motion of the clutch lever being converted into a motion of rotation of the wheel, is already familiar to engineers in the so-called "silent feed" movements used in spinning and weaving machinery. A clutch applied to the periphery of a wheel first grips the wheel, then turns it a little. In weaving machinery the "feed" acts in the direction in which the clutch propels the wheel, but in its application to the arc lamp the action is reversed, for the weight of the carbon-rod propels the wheel in a direction opposed to the grip of the clutch, and the feeding takes place at those instants when the clutch releases its grip. The matter is best studied by reference to actual cases. Fig. 16 depicts the clutch-wheel of Common and Joel. The descending rack, R, drives the wheel, D, by means of the pivot, P. Pivotted loosely around the same arbor is a heavy lever, which is prevented by a stop, S, from descending too far. Pivotted to this lever at L is a second lever, with an enlarged end to grip against the surface of the wheel. The tail of this nipping lever is attached by a pin to the iron core of a solenoid, M. (The latter is wound with a main-circuit coil only if wanted for use in parallel, or with a main coil and an opposing shunt coil if for use in series.) When the current in the solenoid draws up the core, the nipping lever first turns around L and grips the wheel; any further rise of the core will cause the two levers and the wheel to turn bodily together round the arbor, and this second action causes the arc to be struck. Then begins the third period of action, during which the levers slowly descend until the weight lever touches S. Then the fourth period begins; any further descent of the core causing the nipping lever to release its grip, and allowing feeding to take place, followed by a slight rise in the core and renewal of grip.

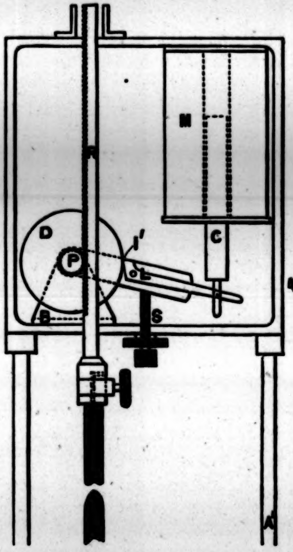

FIG. 16.—COMMON AND JOEL'S CLUTCH WHEEL.

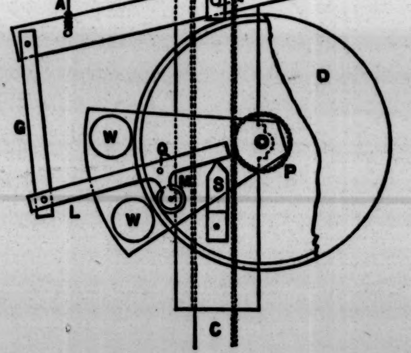

FIG. 17.—BROCKIE-PELL LAMP.

A form of clutch wheel lamp which has become deservedly popular of late is that known as the Brockie-Pell [4,419, 1882, and 1,261, 1885]. The see-saw belonging to this lamp was shown in fig. 6. The descending carbon rod drives a wheel having a strong projecting rim, at the inner surface of which a brake is applied. This consists of a small leather pad, *m*, fastened to a short arm wkich projects downwards from the nipping lever, L, pivotted at Q to a sector-shaped lever behind, which carries two weights, W, W, to increase its downward bearing power. This weight lever is loosely pivotted on the arbor, P, and turns solidly with the wheel when the brake is applied. There is a stop, S, to limit the descent, but it is in this case applied to the tail of the nipping lever. A connecting link, E, joins the nipping lever, L, to the see-saw. The internal position of the brake appears to have two advantages, namely, longer leverage around the fixed pin, making the feed more sensitive, and greater protection from dust and dirt. One peculiarity of the Brockie-Pell lamp is seen by reference to fig. 6, namely, the device by which the core, B, of the shunt coil is allowed a certain travel upwards before i pulls at the see-saw lever, its thinner part passing freely through a swivelled washer, *w*, on the see-saw. But the washer is of iron, and the core has an enlarged head, *h*. These adhere by magnetic attraction when the shunt coil comes into operation.

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[*] Paper read before the Royal Society, March 21st, 1889.

[†] Read before the Society of Arts on Wednesday evening, 6th March, 1889.

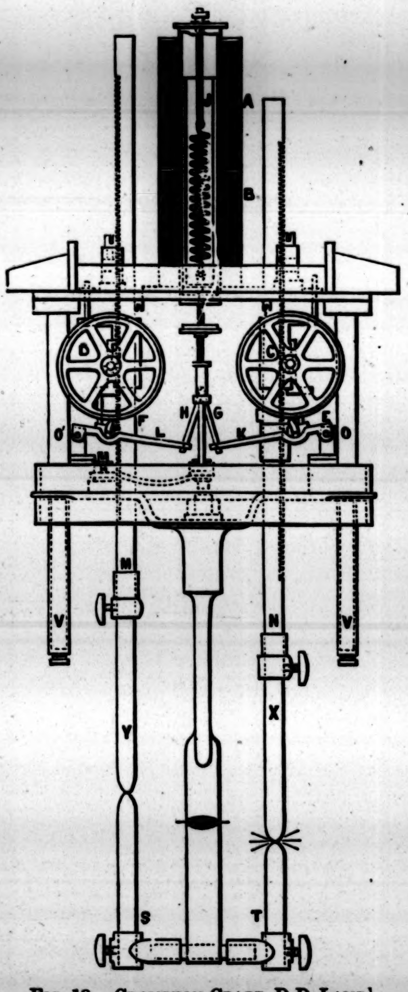

FIG. 18.—CROMPTON-CRABB D D LAMP.

Another very successful form of lamp is the Crompton-Crabb "double differential" [2,539, 1883], shown as a whole in fig. 18 and in detail in fig. 19. In the lamp shown in fig. 18 there are two carbon rods, M and N, of which N comes first into operation, afterwards changing over. On each carbon rod is cut a rack which drives a brake wheel, or, rather, a pair of brake wheels, one behind the other on the same pinion. The arbor bearing is not, as in the two preceding lamps, fixed in the frame of the lamp, but passes through a short sleeve or jockey, which, when the wheel is free to turn, can slide up or down on the carbon rod, but is prevented from turning sideways by a guide pin, *g*, above. Below the brake wheels stands a lever, L, pivotted at *o*, and attached by a link, H, to the core of the solenoid overhead. This lever carries a small table, *t*, and a brake piece, *b*, faced with phosphor bronze. When the lamp is out of action, the free end of the lever is down, and the weight of the wheels and the carbon holder bears down upon the table, *t*, through a pin, *p*, which projects down from the jockey sleeve. In this position the wheels do not touch the brake piece, *b*, and are free. When the current is turned on, the main coil of the solenoid attracts its core, first drawing up the lever, which, turning on its pivot as it rises, brings the brake piece against the rim of the brake wheels and clamps it. Secondly, the wheels being thus prevented from turning, any further rise of the lever lifts the brake wheel, jockey, and carbon holder bodily (the weight of them all resting on the brake piece), thus striking the arc. Thirdly, as the arc burns away, the lever again descends, until, fourthly, when the tail piece rests on the table and takes the weight off the brake, the feeding begins. There are many other points of interest about this lamp which cannot here be discussed.

Other forms of brake wheel have been used with success, notably an elastic band brake, resembling Appold's well known device, applied outside a smooth wheel, in Statter's lamp [2,985, 1885].

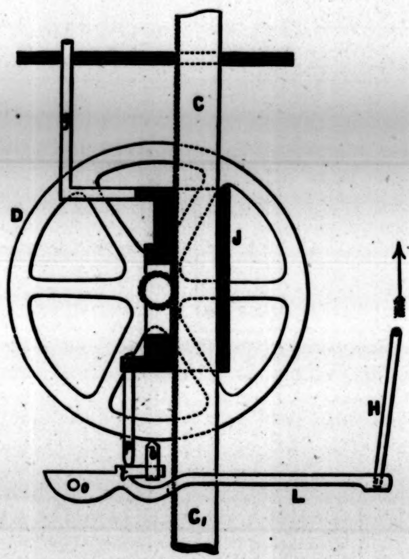

FIG. 19.—BRAKE WHEEL OF CROMPTON-CRABB LAMP.

The most recent form of clutch wheel is that devised by Alexander Siemens [6,987, 1887], illustrated in fig. 20. The lamp to which this device is applied is a holophote lamp for search lights, with a screw feed, the screw being turned by this clutch wheel. It is about one inch in external diameter, and has a projecting rim, R, within which lies an internal metal ring, B, slightly sprung outwards, and cut obliquely, somewhat in the manner of the elastic metal packing rings used in engine pistons. The two ends of this internal split ring are joined, by two pins, to a small lever, L, which projects outwards. When a reciprocating motion, of either large or small range, is imparted to the forked end of this lever, this internal clutch alternately bites against the rim and pushes it forward, and then releases its grip and draws back. This device, which appears to be a really new mechanism, constitutes a true positive feed.

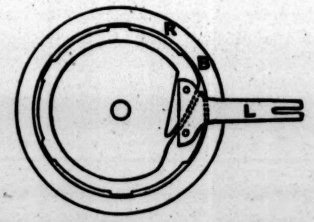

FIG. 20.—SIEMENS'S CLUTCH WHEEL.

The same device re-appears in a recent lamp by Fein [1888] which has a main circuit magnet striking the arc by drawing down the lower carbon, and a shunt magnet for feeding, which vibrates an armature by make-and-break arrangement. The upper carbon holder is smooth, of rectangular section, with a smooth feeding roller firmly pressed by a spring against it. This feeding roller is attached to a clutch wheel like fig. 20. The lamp will work even upside down. Unlike the clutch wheel devices previously described, Fein's feed is non-retractile. The latest patterns of clutch wheel feeds are those of Mackie [7,184, 1887] and Mathis [10,740, 1887]. The advantages of the clutch wheel mechanisms over the clutches that act directly on the rods, may be summed up by the remark that they render the operation of the lamp independent of dust and dirt.

Of lamps with *screw-feed* motions the most recent are the projector lamp of Siemens [6,987, 1887] mentioned above, and a motor lamp by Maquaire, which is now being used at the Kensington Court lighting station. In the latter an ingenious and simple method of reversing the motion of the motor armature is adopted, so that both striking and feeding are accomplished by the same screw. This lamp is further described below.

The class of lamps in which cord and pulley mechanism is employed in conjunction with a long range open solenoid, goes back to the early examples of Archereau and Jaspar. In the more complex Pilsen lamp [Krizik and Piette, 1,397, 1880] two solenoids are used, each with its own coned core, the plungers being connected by cord and pulley, and each bearing one carbon pencil. The arrangement of the circuits of the recent form of lamp is shown in fig. 21, the core, A, being drawn into the main circuit solenoid, C, to strike the arc, whilst the differentially-wound solenoid, F, varies its pull on the core, B, according as the carbons are required to approach, to stand still, or to recede, the former action occurring when the shunt current prevails. The special cut-out mechanism, E F, will be alluded to later.

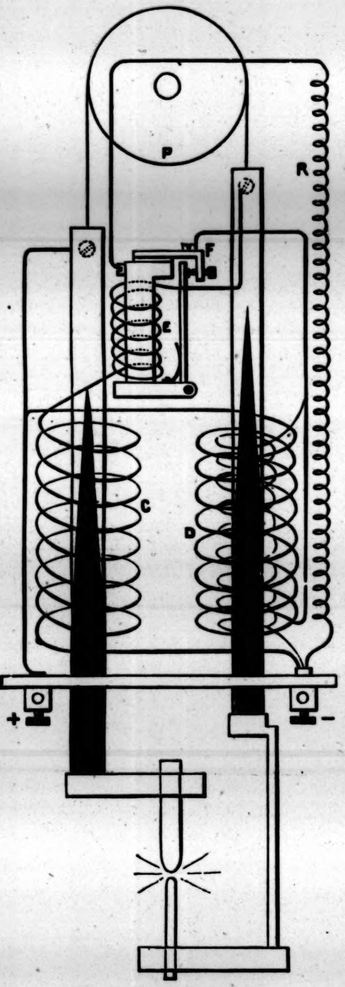

FIG. 21.—PILSEN LAMP.

A much simpler pattern of lamp has been several times described with various modifications in detail by Jaspar, 1878; Romanze [3,901, 1884], Andrews [3,393, 1882], and lastly by Menges, 1887, whose form is shown in fig. 22. Here the long core, S N, is drawn up into the solenoid, wound differentially with a coarse wire, A, and a fine wire winding, B. A heavy piston of metal on the top of the upper carbon holder, *d*, serves both to counterpoise the weight of the core, and to check, as it slides in the surrounding tubes, any too sudden movements. It is often claimed for solenoid lamps that the absence from them of all mechanism renders them superior to all other species of lamps. Yet they are not free from defects; they do not always burn steadily; some of them have the evil habit of "pumping;" and so simple a matter as the elongation of the cord which connects the plungers may put their regulating properties to confusion. In a recent modification by Doubrava the iron cores are fixed, and the solenoid coils slide up and down over them, giving motion to the carbons.

The *screw-feed* lamps have been already touched on. Of these, the most successful in practice is the Cance lamp [3,976, 1881], which operates by the weight of the upper carbon. The screw is prevented from turning by a nut gripped until feeding is necessary. In Siemens's holophote lamp [6,987, 1887], and in Maquaire's new lamp [1889], the mechanical turning of the screw forces the carbons forward.

Amongst *magnetic clutch* lamps the Gülcher lamp, as improved by the Gülcher Company [Whiteman, 1,915, 1882], still holds its own. In this lamp the single counterpoised horseshoe electromagnet—with unequal limbs—sticks itself on by one pole to the iron carbon rod, and by the other pole attracts itself upward to strike the arc. For constant potential work it is a very steady lamp. More recently, magnetic clutch wheels have been used by Dittmar [1886], and by Trott and Fenton [6,910, 1884].

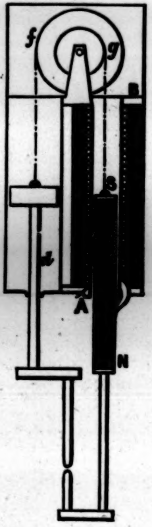

FIG. 22.—MENGES.

Motor lamps have been devised from time to time, those of Tchikoleff, Schuckert, and Gray being perhaps the best until recently. The latest lamp of this type is that of Maquaire [1889]. In this lamp there is a Pacinotti ring upon a vertical pivot, on which a worm is cut. This gears into a large wheel, the pinion of which drives the upper carbon holder by a rack. The motor ring stands between the pole pieces of a powerful electromagnet. By rotating it in one direction it strikes the arc; by rotating it in the reverse direction it feeds the arc. The direction of its rotation is reversed by reversing the direction of the current in it. This is accomplished in the following ingenious way. The coils of the electromagnet are in the main circuit; and from a point midway along these coils a branch wire goes to one of the brushes of the armature. The other brush is connected to the tongue of a sort of relay, and stands between two contacts, one of which goes to one end, the other to the other end of the coils on the electromagnet. By raising or lowering the tongue the armature is thus connected as a shunt, either to one-half of the magnet coils or to the other, the current in it being in opposite directions in the two cases. The tongue of the relay is controlled by a separate shunt coil, which attracts the tongue in order to feed the arc. The feed action of this lamp is extremely delicate.

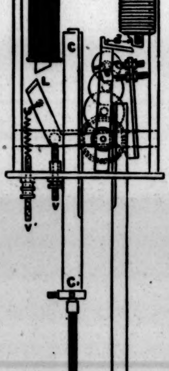

FIG. 23.—DE PUYDT'S LAMP.

It would be impossible, in the scope of this paper, to dwell on the *hydrostatic feeds*, on the various modes of producing *vibrating feeds* and *hammering feeds*, which have been from time to time suggested. The notion of having a *continuous* feed, the rate of which should be varied as required, is an enticing one, but it has never been made a practical success. Neither have the periodic methods of feeding, at which Mr. Brockie made so brave an attempt in 1881; the flavour of which indiscretion still clings about him in spite of the admirable lamps which he has produced in later years. Mr. Brockie's various forms of arc lamp would indeed well illustrate the whole range of the subject, and the same thing might be said about the numerous successive types of lamp produced by Mr. Crompton. Mr. Brockie has lately produced an excellent little projector lamp for use in the optical lantern, having the negative carbon pressed by spring against abutment screws of steel, whilst the upper carbon is fed forward by a nipping lever controlled by a solenoid. *Abutment* lamps and *projector* lamps form separate classes by themselves, which cannot here be discussed.

Many of the points alluded to in the preceding descriptions are illustrated by the action of the De Puydt lamp, fig. 23. This is a rack train lamp which strikes its arc by lowering the lower carbon and raising the upper simultaneously, and feeds with a fly and detent controlled by a shunt magnet. The main circuit magnet, M, attracts obliquely its armature, rocking the train of wheels around the pivot of the first wheel. A lever, L, bent to an elbow which rests on the set screw, V, is also pivotted around the same arbour, and has a vertical arm which carries two attachments; a fork which engages on a pin on the train frame, and a detent which arrests the fly. The other end of the lever, L, is held back by a spring, but can be attracted up by the shunt magnet, S, when the detent is to be released in order to feed.

(To be continued.)

NOTES.

Bank of England Lighting.—The success of the electric light at the Bank of England has promoted its adoption throughout the whole of the new Fleet Street Branch Bank where gas is dispensed with entirely. The installation consists of over 200 lamps of 16 C.P., for which the power is derived from a large Crossley gas engine fitted with tube ignition and other recent modifications. The dynamo is a 12-unit Elwell-Parker, and the accumulators were manufactured by the same firm to the specification of Messrs. Drake and Gorham who carried out the lighting of this bank.

Wiring Buildings.—At a meeting last week of the Philosophical Society of Glasgow, Mr. J. D. F. Andrews read a paper on the "Wiring of Buildings for Electric Light." He touched upon the value of good insulation to protect the wires from moisture, pointing out that wire with vulcanised Indiarubber insulation was superior, and that the pure rubber cotton and compound wires were at no time reliable nor durable. He pointed out the fact that according to the present methods in electric lighting two fuses were necessary—one on each wire—to provide against a short circuit being formed between the wires by the gas pipes, but by connecting one of the leading wires to the gas and water pipes it would only be necessary to have fuses in the other wire, thus saving half the number of fuses. He further pointed out that there was no provision in building lighting against the very dangerous faults of using circuits and partial short circuits, but that the system devised by him, and now extensively employed in ships, consisted of a conductor with a strand of wires laid on outside the insulation to form the return wire. The wires being thus very close together every fault resulted in a short circuit, but notwithstanding this, short circuits were many fewer than in ordinary wiring. Further advantages of this system were that an electric shock could only be obtained through a very small part of one's flesh, the wires being so close together; and in the event of the wire system being struck by lightning there was a direct connection to earth. We hope to deal fully with this in our next issue.

The London County Council and the Electric Light.—At Tuesday's meeting of the London County Council, Mr. Alderman Haggis said the General Purposes Committee had received an important letter from the Board of Trade with regard to electric lighting. It was addressed to Lord Rosebery, as follows:—"My Lord,—I am desired by the President of the Board of Trade to inform your Lordship that the question of electric lighting in the metropolis is at present receiving the serious consideration of this department. Thirteen applications for Provisional Orders under the provisions of the Electric Lighting Acts, 1882 and 1888, in respect of areas within the metropolis, are now before the Board. In dealing with these applications the Board of Trade are at once confronted with two important questions of principle: (1) What should be the extent and nature of the area to be granted? (2) Should or should not concurrent powers be granted to two or more companies within the same area. As regards the former many considerations must be taken into account, *e.g.*, what is the financial position of the undertakers applying for statutory powers in any given area; how far any one company would be in a position satisfactorily to supply such an area; and in connection with this, much would depend on what distance electrical energy for electric lighting purposes can be safely and conveniently furnished from a central station. As regards the latter question, on the one hand it appears to the Board of Trade to be highly desirable to avoid the grave inconvenience to which the public were subjected when there were competing gas companies supplying the same areas in the metropolis, and, further, in the case of electric lighting, that uncertainty exists whether mains can be satisfactorily laid in close proximity to each other. On the other hand, some of the local authorities in the metropolis appear to be desirous to encourage competition, and are anxious to avoid the creation of a monopoly or *quasi*-monopoly for electric lighting by giving any company exclusive powers for any one area. Before deciding on the action to be taken on the applications at present before the Board of Trade, they propose to adopt their usual procedure, and so hold a local enquiry, of which full notice will be given, and at which all those interested can be heard; but they are anxious to take no definite step which may have important bearing on the future policy to be pursued with regard to electric lighting in the metropolis, without communicating in the fullest manner with the County Council of London. In this determination they are greatly influenced by the consideration that before long the jurisdiction which the Board of Trade now exercise in regard to electric lighting matters in the metropolis may be transferred to the County Council, and they would therefore be most unwilling to take any action which might hamper that body in dealing with the question in the future. With this view they propose, as soon as the report of the enquiry has been received, to forward it to your lordship for the information of the County Council, and I am at the same time to express a hope that this Board may then be favoured with any observations which the County Council might wish to offer upon this large and very important question." Sir Thomas Farrer said the President of the Board of Trade was most anxious to carry the County Council with him. The subject was left with the committee, which had asked the Board of Trade for particulars of the 13 applications. The local enquiry was fixed for April 3rd.

Electric Lighting at Harleston.—Messrs. Laurence, Paris & Scott last week gave the people of Harleston an illustration of street lighting by electricity, a lamp of 200 C.P. being fixed in the Market Place. A 16-C.P. lamp was also run in the bar of the Magpie Hotel.

Gas Companies and the Electric Light.—It is announced that General Andrew Hickenlooper, president of the Cincinnati, Ohio, Gas Light and Coke Company, has determined on the introduction of electric lighting on a large scale by that company in conjunction with its gas service. As this company is noted for not doing things by halves, we may expect soon to see Cincinnati one of the best lighted cities in the country.—*Progressive Age.*

Electric Lighting in Berlin.—The report of the special electrical commission appointed by the Municipality, and which consisted of MM. Bulls, Bède, Depaire, Martiny, Pilloy, Wybawd, and Ysieux, have reported that they consider that though it is advisable for the town to keep in its hands the monopoly of electric lighting, the industry is not yet so far advanced as to justify the Municipality in taking up the matter themselves. A concession is recommended, the town to have the right to take over the installation after three, six, or nine years. Offers have now been invited. The mode of distribution is to be such that the current can be applied both for lighting and motor purposes. Either a high or low tension current, transformers or accumulators, or a mixed system, may be used. The central station for low tension currents would be situated in the Pavillon Nord des Halles, where the price of the ground is £2 per square foot. A secondary station could be erected near the Eden Theatre. For high tension currents the central station would be erected at the gas works, where the cost of the ground is 5d. per square foot. The installation is to be so carried out that its capacity can be doubled without new land having to be bought. The Municipality intend that the first extensions of the lighting are to include 120 arc lamps on the interior Boulevards, the Flemish Theatre, and the Park. It is proposed that the cables shall be laid underneath the roadway or footpaths, and in addition the large sewers can be used. In the Anspach and Nord Boulevards, and in the Rue de Fripien, the mains are to be doubled. The Municipality reserves the right of fixing the sale price.

Church Lighting.—Square Church, Halifax, was last week illuminated by 13 Sunbeam lamps, each of 200 C.P. The experiment was a great success.

Electric Lighting in Bideford.—The establishment of Messrs. Tardrew, in High Street, Bideford, has just been fitted up with Edison-Swan and Brush Victoria incandescent lamps, an arc lamp illuminating the doorway. Current is supplied by an Elwell-Parker special compound-wound dynamo, driven from an 8 H.P. Corliss engine. The whole of the work has been carried out by Messrs. Tardrew, under the instructions of Mr. J. W. Ridd, of Barnstaple.

Reading and the Electric Light.—Reading, the county town of Berkshire, is anxious to have the electric light, and, by way of experiment, the authorities lately had a number of poles, each carrying a 1,200 C.P. lamp, erected in the main thoroughfares. The lamps were lighted for an hour or two, and were voted highly successful.

The Electric Lighting of Barnet.—Mr. Joel is in a difficulty at Barnet. By the terms of his contract he is bound to place his wires underground by a certain period; but the Board of Trade has laid down that streets should not be taken up for this purpose until statutory powers have been obtained, and these powers Mr. Joel does not possess. Moreover, the formalities in connection with the obtaining of a license or Provisional Order require the lapse of several months before it is granted, and in the case of Barnet the contractor, if compelled to wait for these formalities, would not have sufficient time left to comply with the terms of his contract by the date specified. The Barnet Local Board has resolved to represent the whole case to the Board of Trade with the view of bringing about some modification of the Board's regulations in order to meet the special circumstances.

A Large Cable.—The Telegraph Construction and Maintenance Company, Limited, has just manufactured for the Post Office the largest shore end cable which has hitherto been constructed. The cable is a 4-core one, and is very heavily armoured, weighing nearly 28 tons per mile.

The Edison and Swan Company's Concert.—The second annual concert was held at the company's works, Ponder's End, on Wednesday evening last. Nearly the whole of the *employés* availed themselves of the kind invitation of Major Flood Page (secretary), and Mr. Gimingham (resident superintendent). Before the concert commenced Major Flood Page addressed a few words of welcome, couched in very appropriate terms. The entertainment was a complete success, the songs, &c., of the ladies and gentlemen who volunteered their services being much appreciated. Mrs. Gimingham and Miss Goater accompanied the singers. A sketch entiled "A Curious Dilemma" was very ably rendered by a few of the *employés*. The programmes were tastefully got up for the occasion, a striking and pleasing feature being a series of unique designs by Mr. Watson, bringing into prominence the company's manufactures, such as incandescent lamps, fittings, and miner's safety lamps. The large room in which the company assembled was lighted throughout with coloured electric lamps, and a drop scene, painted by Mr. Watson, was very much admired. The singing of the National Anthem, and a vote of thanks to the secretary and manager, which was heartily responded to, terminated a very pleasant evening. The whole of the arrangements were under the direction of Mr. Robson.

Fire Brigade Alarms.—A most complete and successful system of electric alarm calls for the Newmarket Fire Brigade was designed and fitted last year by Mr. Henry J. Dale (Messrs. H. Dale & Co.), of Ludgate Hill, and he is now engaged in a further extension of the work. A number of the principal trainers' establishments are connected with the fire brigade office, so that at any hour of the day and night they can call the services of the brigade. Again, the two county police stations (for Newmarket is in two counties, Cambridgeshire and Suffolk), are connected so that by arranged signals and the use of Morse keys, assistance can be obtained for either the fire brigade or a trainer's premises, in cases of burglary, &c. The apparatus at the central fire office consists of a large annunciator arranged on a large mahogany glass front case, with the dial lettered with the names of the various trainers and gentlemen already connected, and also the police offices, with spaces left for others to be connected from time to time. The alarm is then given on a large continuous ringing bell, so that when the captain of the fire brigade arrives he can see by indication who rings, and can then stop the bell. Below the indicator is a series of massive switches, which by one movement can put all or any number of the twenty-one firemen residing in different parts of the town into communication, causing a large bell to ring in each man's house until the switch is reversed. Special keys are provided to telegraph to the police stations, and also arrangements are made so that by no carelessness or hurry can the bells be left ringing when not needed. The whole of the central office is worked by one battery of 44 Leclanché cells. During the past winter its utility has been tested on numerous occasions with unvarying success, and, as before mentioned, Messrs. Dale & Co. are now adding to the connections. The local board, and the inhabitants generally, are so convinced of its necessity, that permission has readily been given for the overhead lines and poles Messrs. Dale required to fix. In a town like Newmarket, where racehorses of great value are always in the trainers' stables (and especially at race times), the security given by such electric communication is of the highest value.

Strange, if True.—There are strange rumours afloat respecting the position of the Electrical Traction Syndicate. First of all, we are credibly informed that a big company is about to be registered to work the system; and later we hear that Messrs. R. E. Crompton and Company, Limited, have taken the whole thing over. Which is correct? The same report was current respecting the almost defunct Elieson Company and Messrs. Crompton, so it is possible that the latest rumour has about as much truth in it.

The British Museum.—For the further protection of our national treasures, a complete system of electric alarms has been designed and fitted for the Commissioners of H.M. Works by Mr. Henry J. Dale (H. Dale & Co., Limited), of Ludgate Hill. Pulls with special indicators are so arranged in various parts of the buildings in communication with the firemen's room and with the front hall of building, that upon any alarm of danger by fire or dynamiters, &c., being given, not only are the police and firemen, by means of an annunciator, informed of the situation from which the alarm is given, but by an automatic relay an alarm is also given at all the entrances and in the principal librarian's house, so that precautions could be at once taken by the police to prevent the escape of any suspicious visitors. The above arrangement has met with the entire approval of the authorities.

Obituary.—We regret to hear of the rather sudden death, from congestion of the lungs, of Mr. Joseph May, the well known electrician of the Telegraph Construction and Maintenance Company's Works at Greenwich.

Sale of the Elieson Company's Plant.—The catalogue of this important sale, which is to be conducted by Messrs. Wheatley Kirk, Price and Goulty, on the 17th of April, is now ready. It describes in detail the leading features of the system, and gives full particulars of the British, Foreign, and Colonial rights. The electric tramcar station and plant at the Plashet Hall Works, Stratford, are well described, and illustrated by photographs. The station and equipment can be viewed any day by written order from the solicitors or auctioneers, and it is intended to show the system in operation two days prior to and on the morning of sale. At the back of the catalogue is a map showing the position of the works and the time of the train service from Liverpool Street.

Anglo-German Telegraph Tariff.—From the 1st of April the telegraph rate between Germany and Great Britain will be reduced from 20 pfenniges (2½d.) a word to 15 pfenniges.

The Central Subway Railway.—The Select Committee on Railway and Canal Bills has decided not to take into consideration the Central Subway (Electric) Railway Bill (together with several others) until after the Easter recess. In the meantime no fewer than 17 petitions have been lodged against the Bill. The London County Council having now taken over the powers of the Metropolitan Board of Works, will have time to decide whether or not it will proceed with the petition of the defunct body.

An Electric Light Present for the Prince of Wales.—Lady Knutsford, wife of the Secretary of State for the Colonies, recently attended at Marlborough House, and on behalf of the Colonial committee, representing subscribers in the British colonies and dependencies, presented to the Prince and Princess of Wales, as a souvenir of their silver wedding, a handsome clock and candelabra, together with two large wall lamps fitted for electric light.

Electrical Classes.—Good work in technical teaching seems to be done at the Pitlake Institute at Croydon. The electrical engineering classes are conducted by Mr. W. Perren-Maycock, A.I.E.E., who frequently has a large, and sometimes a distinguished audience—visitors, that is to say, such as do not usually attend technical classes. We wish Mr. Maycock success in his efforts to instruct the youth of Croydon in the mystery and art of electrical engineering.

Electric Lighting at Ballymena.—Several mills and workshops in Ballymena are lighted by the electric light, Mr. C. MacCarthy having in all cases carried out the installations. Mr. J. Gault has 15 lamps in his meal mill and a large number in his saw mill and coal stores; Messrs. Kave Bros.' foundry is lighted by 30 lamps, whilst over 400 are installed in the factory and bleach works of Messrs. J. H. and G. Bellis, Messrs. Morton & Cos.'s flour mill, Messrs. Raphael & Wolseley's handkerchief factory. Mr. Thomas Anderson's residence, and other places are also lighted, and altogether Ballymena has shown itself well abreast of the times in the matter of electric lighting.

The Royal Society.—Amongst the papers down to be read yesterday was one by Prof. Schüster, F.R.S., on "The Diurnal Variation of Terrestrial Magnetism."

Electrical Trades Section.—At yesterday's meeting of the Electrical and Allied Trades Section of the London Chamber of Commerce the following agenda was submitted:—1. Formation of the Standardising Committee to consult with the Institution of Electrical Engineers. 2. Railway rates question. 3. Formation of a Vigilance Committee to watch the proceedings of the Board of Trade, local authorities, and other bodies, in so far as they affect the electrical industry. 4. Other matters.

A Noteworthy Bill.—A bill was recently introduced in the Pennsylvania Legislature providing that any company, incorporated in the State for the purpose of supplying light, heat and power, by whatever means, shall have exclusive rights in its chartered district "until the said corporation shall have from its earnings realised and divided among its stockholders during five years a dividend equal to 8 per cent. upon its capital stock."

Printing by Electricity.—The proprietors of the *Star of the East*, the evening edition of the *East Anglian Daily Times*, published at Ipswich, deserve credit for their enterprise in adopting electricity for working their printing machinery. The first experiment was made on Saturday last, when the dynamo usually employed to light the building was used as a motor, and current was transmitted by means of a half-inch cable from a set of accumulators at the works of Messrs. Laurence, Paris and Scott. This was, we believe, the first attempt to print by electricity in this country. The advantages of electric motive power in the printing offices of Fleet Street and the surrounding neighbourhood, where every square foot of space is important, must be obvious to our readers, and when the central lighting stations are all in full swing, we quite expect to find the companies devoting attention to the distribution of motive power.

Personal.—Messrs. Mather and Platt, of Salford Ironworks, Manchester, have opened a London office at No. 16, Victoria Street, Westminster, which will be under the charge of Mr. Hardman A. Earle, who has been for some years the assistant manager of their electrical department.

Mr. A. B. Blackburn, Assoc. Mem. Inst. C.E., has resigned the position which he has held for some years as resident engineer to the Edison and Swan Company, and has joined the staff of Messrs. Mather and Platt's electrical department, as assistant manager.

Society of Arts.—On Monday evening next Mr. C. V. Boys, F.R.S., will deliver the second of his Cantor lectures on "Instruments for the Measurement of Radiant Heat."

An Overhead Wire Accident.—During a storm in Westmoreland, last week, six miles of telegraph wire were torn down and strewn along the Eden Valley Railway, and while a train was trying to advance the fireman was dragged off his engine by a falling telegraph post, and more or less injured.

The Macræon Secondary Battery.—This battery, recently described, in American exchanges, seems to possess some good points. The attempt has been made to take advantage of the best characteristics of the Faure type of cell, and to avoid those of a troublous nature. The negative plate is made according to the Faure process, as distinguished from the Planté. A framework of lead is filled in with active material obtained by fusion. The cross bars making up the frame are thinner than the finished plate, so nothing but the active material is exposed to the liquid. The negative plates are permanently connected to the metallic box, which takes the place of the glass or rubber boxes now generally used. The positive plates are made according to the Planté plan; the active material is obtained from the support itself by the chemical action of the current. But instead of the forming process taking months to accomplish, as in the original Planté process, it is accomplished in a few hours, the result of the special electrolyte used in the Macræon battery. The form of the positive plate is also an important question. In this cell it is made of corrugated strips of lead, fastened at the top to the cross bar of a lead frame, while at the bottom they have a freedom of movement which prevents "buckling" when the strips expand on discharge. These positive plates are fixed to the metallic top of the box. When the cover is in place, the top of the cell is positive, and the bottom is negative, with an insulation between them. From data published in *Science* obtained from cells of both the lighting and tramcar propulsion type, the batteries appear to give excellent results.

NEW COMPANIES REGISTERED.

Bath Electric Light Company, Limited.—Capital £25,000, in £10 shares. Objects: To carry out an agreement of 8th inst. between C. J. Wharton, F. J. Down, and A. F. Davies of one part, and John Chivers of the other part, for a licence to use and work the Thomson-Houston system of electric lighting in the city of Bath, and within a radius of five miles from the Guildhall therein; and also an agreement of 8th inst. between the Anglo-American Brush Electric Light Corporation, Limited, and John Chivers, for the sale and purchase of plant, machinery, and goods manufactured by that company; also an agreement of 8th for the purchase from John White of the lease of the Bathwick Mill, Bath; also an agreement of 8th inst. for the appointment of Hy. George Massingham as managing director, superintendent of works, and electrical engineer, and for the assignment by him and assumption by the company of a contract dated 1st ult., entered into with the Corporation of Bath for lighting certain portions of that city by electricity. Signatories (with 1 share each): *Major-Gen. James Burn, *Major-Gen. G. Annesley Benson, *H. G. Massingham (electrician), *J. Chivers, A. Taylor, J. Ricketts, W. Jeffery, all of Bath. The signatories denoted by an asterisk are the first directors. Qualification: 100th part of the subscribed capital for the time being; remuneration £50 on every £5,000 or fractional part of £5,000 of capital, subject however, to the prior payment of 5 per cent. per annum dividend. Registered 21st inst. by Shaw and Blake, Doctors' Commons, E.C.

Corinthian Electro-Medical Battery Company, Limited.—Capital: £25,000 in £1 shares. Objects: To manufacture machines and apparatus for the automatic delivery of goods, or for the automatic performance of any act or operation; also to carry on business as mechanical engineers, electrical engineers, and general merchants, and to enter into an agreement with Charles Longbottom Hindle. Signatories (with 1 share each): *E. L. Lovell, Castlenau, Barnes; *F. T. Rushton, Hove, Sussex; A. Bellingham, 23, Albert Square, S.W.; C. A. Bury, Highfield House, Leeds; G. M. Duncan, 19, Gordon Street, W.C.; C. Spencer, 47, Durham Road, Manor Park, Essex; C. J. Downie, County Bay, North Berwick. The subscribers denoted by an asterisk are the first directors. Qualification: £100 in shares or stock. The company in general meeting will determine remuneration. Registered 24th inst. by Charles Doubble, law stationer, 14, Serjeant's Inn, Fleet Street.

Planet Electrical Engineering Company, Limited.—Capital, £20,000, in £5 shares. Objects: To carry on business as electricians, mechanical engineers, and suppliers of electricity for the purposes of light, heat, motive power or otherwise, and as manufacturers and dealers in electric apparatus and appliances. Signatories (with 1 share each): R. Cecil Batley, Crewkerne; J. H. Newman, 2, Great George Street, S.W.; H. E. Moojen, 18, Broadway, Streatham; F. J. Webster, 7, Great St. Helens; F. Jago, 2, Victoria Mansions; J. Strick, 2, Victoria Mansions; A. L. Shepard (electrical engineer), 2, Victoria Mansions, S.W. Registered 26th inst., without article of association, by F. J. Webster, 7, Great St. Helens, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Elwell-Parker.—The annual return of this company is dated 24th December, 1888. The nominal capital is £50,000, divided into 4,500 A and 500 B shares of £10 each. 2,580 A shares are taken up and are fully paid.

Magnetic Bell and Signal Company, Limited.—The registered office of this company is now situate at Catherine Chambers, 8, Catherine Street, Strand.

Eastern Telegraph Company, Limited.—The annual return of this company, made up to the 7th ult., was filed on the 19th inst. The nominal capital is £4,700,000 divided into 70,000 preference and 400,000 ordinary shares of £10 each. The shares taken up are 70,000 preference and 399,988 ordinary, upon which the full amount has been called. 20,000 of the ordinary shares were issued at £12 per share on the 24th November, 1888, and are now fully paid up. The paid up capital is £4,699,880.

Black Sea Telegraph Company, Limited.—The annual return of this company, made up to the 7th ult., was filed on the 19th inst. The nominal capital is £150,000 in £10 shares. 13,000 shares are taken up and are fully paid.

Colchester Electric Light and Power Company, Limited.—The annual return of this company, made up to the 13th inst., was filed on the 19th inst. The nominal capital is £25,000 in £10 shares. 130 shares are taken up, and £6 per share has been called thereon, the calls paid amounting to £780.

Douglas Patent Clock and Electric Meter Company, Limited.—The statutory return of this company, made up to the 20th inst., was filed on the same day. The nominal capital is £10,000 in £10 shares. 211 shares are taken up, 90 of which are issued as fully paid to the vendor. Upon 121 shares £5 per share has been called and paid. Registered office, 77, Colmore Row, Birmingham.

Eastern and South African Telegraph Company, Limited.—The annual return of this company, made up the 2nd August, 1888, was filed on the 19th inst. The nominal capital is £400,000 in £10 shares, the whole of which are taken up and are fully paid. By a resolution of 22nd November, it was resolved to increase the nominal capital by the addition thereto of £200,000 in 20,000 shares of £10 each, beyond the present registered capital of £400,000.

CITY NOTES, REPORTS, MEETINGS, &c.

Submarine Telegraph Company, Limited.

An extraordinary general meeting of this company, over which Sir Julian Goldsmid, the Chairman, presided, was held at the offices, 2, Throgmorton Avenue, London Wall, E.C., on Monday, for the purpose of considering, and, if thought advisable, deciding as to the offer of Her Majesty's Government, and the Government of France, of purchasing the company's cables.

Mr. S. M. Clare, the Secretary, having read the notice convening the meeting,

The Chairman said he should have to trouble the shareholders at considerable length, in order to give them a full account of the state of affairs with which they had at present to deal. He must take them back to a period dating from July 16th, 1878, more than ten years ago. At that date they made an agreement with Lord John Manners, who was then Postmaster-General, which, besides providing for giving to the Post Office a proportion of the receipts which came in from the telegraphic communications with the Continent, also contained a very important clause (clause 8) which read as follows :—"The agreement shall take effect from June 1st, 1879, or so soon after that date as the French and Belgian Governments shall have granted a renewal of the concessions to be applied for, and shall remain in force until December 31st, 1898; but no alteration of the existing tariffs shall take place unless and until this agreement shall come into operation." That agreement was signed, and his (the chairman's) predecessor, the late Sir James Carmichael, forthwith made application to the French Government, which was always considered the leading Government with regard to the arrangements between the Post Office and the Telegraph Company, for a renewal or extension of the concession, which, as they knew, expired early this year. The French Government on that occasion, and in three subsequent years, absolutely refused to grant the request, saying that the application was premature; the time still to elapse was far too long, and they therefore declined to consider the question. So matters went on until three years ago, when he (Sir Julian) thought he would make a determined effort to obtain a renewal of the concession in order to put the agreement to which he had alluded, and which was practically only a draft agreement, into force. Without going through all the events of those three years, he might say that they negotiated with four successive Ministries, and with practically three of them very nearly came to a conclusion. The last Ministry with which they negotiated was that of which M. Rouvier was head. M. Rouvier was particularly capable of considering this question, because he had attached to his own Department of Finance that of Posts and Telegraphs, which had previously been a separate and independent department. The result of the efforts made by many of the directors was that M. Rouvier informed them in writing that he was prepared to grant a renewal of the concession for 10 years. Then occurred, what had already been mentioned, a diplomatic note on the part of Her Majesty's Government, in which they requested the French Government not to grant the renewal of the concession. The directors maintained that under the agreement with Lord John Manners they had no right to do this; but the argument of the Government was that as a reasonable time had elapsed since the signing of that agreement, and no renewal of the concession had been obtained under section 8, they were no longer bound by the agreement, which had not been put into force; the policy of the Post Office, and therefore the policy of the Government had changed, and they had determined to make arrangements with foreign Governments by which all telegraphic communications between England and France, England and Belgium, England and Holland, and England and Germany should be in the hands of the respective Governments. The directors thought that, considering the agreement they had, it was extremely hard on the proprietors of that company, who had been led to believe that they would in all probability obtain a renewal of the concession. But he supposed English Governments were like all other Governments, and seemed very hard on the interests of private companies. He believed it was said that they had had a very good thing for many years, and as the policy of the Governments had changed they had no right to expect a further renewal of the concession. The position eighteen months ago was that they had obtained a promise of the renewal of the concession, and that was about to be carried into effect when the English Government prevented it. Then they made arrangements with the French Government by which they should jointly acquire the cables between France and England, and similar arrangements with the Belgian Government with respect to the cables between Belgium and England. They also agreed with Germany that one of the English-German cables should remain in the hands of England and that the German Union cable should be acquired by Germany. This brought him to a point of importance with regard to the German Union Company. That company had a concession, which was not an exclusive concession, and there were still about 11 or 12 years to run. It would have been possible for the German Government themselves to lay down other lines or make arrangements in some way for competition. As they decided to take the telegraphic communication into their own hands they gave notice to the company, and the result was that they came to an agreement with the directors by which they refunded the capital of the company with a bonus of 25 per cent. upon it. In some communications which the directors of the Submarine Company had with the Government they pointed to that as an example of what would be a fair thing for the English Government to do, but the latter did not see the argument in the same light that they did. Then came the question of what was to be done at the end of the concession. They had frequent interviews with Her Majesty's Government, who were authorised and requested by the French and Belgian Governments to carry on communications with the Submarine Company on behalf of all the Governments. The sum and substance of the negotiations with Mr. Goschen and Mr. Jackson, the secretary to the Treasury, was originally that they should sell them the French and Belgian cables at a valuation price, the valuers to be appointed—one by the Government, one by the company, and an arbitrator in the usual manner. That proposal was so well known to everybody in connection with English law, and was in itself so fair, that it commended itself to them. That was the very first point upon which they easily came to an agreement, and it was understood that it was practically settled and done with. But to their intense surprise only three months ago they were informed that the French Government had decided that they would have nothing to do with this method of valuation, and must have some other system. This other system would be less satisfactory to the shareholders of this company, and less fair from their point of view. After negotiations, which were of a protracted and troublesome character, it was eventually decided that the Governments were to appoint officers to test the cables to ascertain exactly their electrical condition, and that they should make an offer based upon the results of that test. Officers were sent, and tests were applied, but he thought he might fairly say that those tests were such as were only applied to cable in the course of manufacture, in the laboratory, and not to cable which had been at the bottom of the sea for some period of time. Their (the directors') contention had always been that the value of the cables as a commercial instrument was practically unimpaired. Upon that point he thought he ought to say a word or two, because allegations had been made with regard to the condition of the cables which very seriously affected the question. They must be aware that a cable at the bottom of the Channel was not in the same position, either absolutely or relatively, as a cable at the bottom of the Atlantic, or in other deep water, because it was liable to fracture or damage from the anchors of fishing boats, and in many other ways that cables at the bottom of the sea were not. On one occasion the anchor of a fishing boat having brought up the cable, instead of uncoiling and freeing the cable the fishermen chopped it in two, and allowed the ends to sink back to the bottom. It was not always easy to find the authors of such proceedings. For these various reasons the cables must be repaired frequently when they were at the bottom of the Channel, whereas at the bottom of the ocean they might lie for years undisturbed, and no cable in the Channel could be entirely free from the need of constant repair. But, as a curious fact, he might mention that during the last five years the repairs had been less frequent than during either of the two previous periods of two years. The result of the testing of the cables was that allegations were made that they were patched cables, which he had just explained they must of necessity be, even if laid only a year or two ago; and in addition to that the officials did not consider that they were in an electrically perfect condition. The directors had pointed out that so far as the cables were concerned they practically did the work, did it very well, and without any impediment to the traffic, and therefore they were in a perfect condition from the business point of view. The result of all these proceedings had been that they had had two letters, which he called upon the secretary to read.

The first letter, which was then read by Mr. Clare, was to the effect that following upon the electrical examination of the four cables connecting this country with France, and the cable between Jersey and France, and the examination of the log-books, &c., of the company by officers of the British and French telegraph departments, the delegates had made a report as to the amount which, in their opinion, should be paid as representing the value of the cables, and the Governments of the two countries, after full consideration of the facts, had accepted that valuation, and offered the sum of £14,000 as the amount which it was proposed to pay in respect of those cables; a subsequent letter from Mr. Patey, secretary to the Post Office, stated that there was a difference of opinion as to the proportion of the £14,000 which should be assigned to the Calais cable, but it might be taken as about £2,400. A letter identical in terms was then read with respect to the Belgian cables, for which the sum offered was £9,000. A further payment of 10 per cent. on the sums named was in each case promised, provided certain conditions relating to the prompt acceptance of the offer were complied with.

The Chairman, resuming his remarks, said the directors considered the matter of such importance that without express authority they ought neither to accept nor to reject the offer, and they decided to bring it before the shareholders. He informed the Chancellor of the Exchequer that they had taken the earliest day open to them of consulting the shareholders, and that until that meeting they could not give a definite reply. They would expect from him some information with respect to the value of cables calculated to do the business which was to be done, and which had been done by the cables in question. Mr. Clare had calculated that it would cost the sum of £59,305 to lay down four new cables in the place of the four existing cables between England and France, and the cost of two new cables to Belgium over the same line as the present cables would be £33,678, so that six new cables would cost now £93,073. The Government offered for the French cables £12,430, and for the Belgian, £9,900, or £22,330 for the whole, 25 per cent. only of the cost of new cables. He had excepted in this statement the fifth French cable. The result of an interview several of the directors had had with the representatives of the Government, was that any money to be paid would be paid by the English Government direct, and they would arrange terms with the French Government. They had always calculated that under the worst terms the valuation by arbitration would give them at least 50 per cent. of the cost of new cables, and some people were sanguine enough to believe that they might get as much as 75 per cent; therefore, from that point of view, they were getting a very small proportion. Another aspect of the question which, although not so important, ought to be communicated to them, was that the French cables earned in the last half year about £28,900, and the Belgian cables earned £11,930, or £40,830 in all. Allowing £17,000 for working expenses, there was left an income of £23,830. Therefore in three months the net income of the cables was a little more than the total sum offered for them. From that point of view the Government would get a very good bargain. Now the question arose, ought they to accept or reject that offer? If they accepted it, what would happen? If they rejected it, what would happen? He thought they would understand that the directors had found themselves in a most difficult and embarrassing position. But he might say on behalf of his colleagues, as he could say on his own behalf, that they had done all in their power to promote a decision which might in the end be in the interests of the shareholders, and if they had to lay such an unsatisfactory state of affairs before them it was not owing to any lapses on their part, but was owing to the circumstances of the case, over which they had no control. If they accepted the offer they would receive for the cables a sum which they considered to be greatly below their value. Then there were left to them two other cables, one leased to the Paris and New York Company, which, under agreement, they would purchase for about £7,000, and another leased to the Anglo-American Telegraph Company, with regard to which they had not come to terms, but which they trusted would be purchased by the Anglo-American Company. But there was no need to go further into the matter of those two cables. What they had now to consider was the offer of the Government for the four cables to France and the two to Belgium. If they declined, then he must fairly put before them what in his opinion was the position of affairs. They were told that the French Government were anxious to lay down new cables altogether; they thought it would be better to begin business by doing so rather than by purchasing the cables of this company. Therefore there was the chance, if they refused this offer, that the two Governments would say that they would not purchase their cables at all, in which case they would be worth only their picking up value, whatever that might be. That was a consideration which the shareholders must carefully weigh. Upon that point the shareholders were entitled to ask the directors if they had done their best and their last in order to induce the Governments to consider whether they could not make an offer more adequate, more suitable to the occasion, for the Government would be obtaining an investment by which they would earn an income for the country such as no other Government investment produced, and which ought therefore to allow them to deal, he would not say liberally, but justly, with the shareholders of the Submarine Company. Well, they had done their best in that direction, and some of them flattered themselves that they had produced some slight impression on the heart of the Chancellor of the Exchequer, which ought to be stony, but which he could not help believing in that case might not be so. He and his colleagues had united in urging upon the Chancellor of the Exchequer to examine those points which he had ventured to put before them, in order that he might see that they were not getting what ought to be considered a reasonable price for their property, and, although he had no right to say so, he had slight hopes that there might be an improvement in the offer made. Consequently, if they asked him (the chairman) what they had better do under all the difficulties of the situation, he should advise them to pass some resolution such as he would now move, which he had carefully considered, and which he believed met the best view of the case: "That the directors be requested to inform the Government that in the opinion of the shareholders their offer of £22,330 for the purchase of the company's cables between England and France, England and Belgium and Jersey and France, is far below their value; that the directors be authorised to allow the Government to work the cables on and after April 1st next, to continue their negotiations, and to sell the cables to the Government at the best price they can obtain; and that the directors inform the proprietors, by circular, as soon as possible of the result of their further negotiations." Why he asked them to give the directors that authority was because he hoped the Chancellor of the Exchequer would give them something more than the amount which had been mentioned. In his opinion it was advisable that they should be authorised to conclude this matter in order to avoid greater risks, greater dangers, which might fall upon them. The Government of England would take over a great deal of property which did not concern the Government of France; they were going to take over the house in which they were then met, the stores, ship and country stations, everything, in fact, hitherto used by the company in working the business, and most important of all, they were going to take over their staff with very few exceptions. The best relations had always existed between the staff and the directors, who represented the shareholders; the staff had been of opinion, he thought, that the directors had endeavoured to look after their interests as well as those of the shareholders. Therefore, while looking after the interests of the shareholders, the directors had also been anxious that no man, if possible, should lose his place. The result of that was that the staff would, with a few exceptions, be taken over in its entirety. What would they do for those not taken over? After some discussion it was agreed to give two years' salary as a bonus to those officers who did not pass over to the service of the Government, provided that the amount which was so paid did not exceed £5,000. They made a representation to the Government that the officers thus retiring would require £5,800 in order to receive the two years' salary to which they would under this arrangement be entitled, and asked them to extend up to that amount; they agreed to extend to £5,500, but would go no further. Consequently he had to ask the shareholders to authorise the directors to pay the other £300 out of the funds of the company. That was the exact position of affairs. He would now give them a little information with regard to the Calais cable, which was the fifth cable to France, and which belonged to the French company Carmichael. That was the 'original cable which first did the business between England and France; but, according to the tests of the French officials, it was the best cable of all. This contradicted their statement that the cables were, by reason of the length of time they had been down, necessarily not of great value, and confirmed his (the chairman's) assertion that a cable between England and France did not depend for its value upon age, but that it was a question of treatment. They were willing to pay more in proportion for that cable than for any one of the others. That matter would have to be settled on Saturday by the French company; but the course taken by this company would mainly guide the French company as to what it should do.

Mr. Robinson, after remarking that the sum offered by the Government was ridiculously low, asked why the amount had not been stated in the notice convening the meeting. He did not think the shareholders should have been taken by surprise in the way they had been. He suggested that if the offer was not increased they should put the Governments to as much inconvenience as they could by refusing to carry their messages.

Mr. Raynes enquired what the picking up value of the cables would be, and whether the offer of the Government for the remaining property of the company was on the same scale as that for the cables.

The Hon. H. R. Brand, answering these points, said it must be obvious that the company owed a duty to the public beyond the duty to Government, and it would be a most fatal thing to put themselves in the position suggested by Mr. Robinson of refusing facilities for the transmission of messages. He hoped shareholders would not be carried away too much by passion. If they had followed the Chairman's remarks, they would see that the amount in question, although the offer made was a most objectionable one, was not a very large one, really only from £15,000 to £25,000. The picking up value of the cables, he should say, was almost *nil*; that was to say, it was scarcely worth while to pick them up.

Mr. Griffiths said he was quite sure that the shareholders did not wish to put themselves in antagonism with the Government. But it seemed to him that one question had not been considered. Had the Government Parliamentary authority to deal with this matter? He suggested that the question should be raised in Parliament, and that enquiries should be made as to the relations between the English and French Governments in the matter. He did not believe that Parliament would see the shareholders of this company unjustly dealt with.

Mr. Soden spoke at some length upon what he termed the act of spoliation to be committed by the English Government, without the warrant of Parliament, at the dictation of the French Government. The offer was not 1s. 4d. in the pound on their capital. He would like to know what the bargain was that the English Government had made with the French which had driven them to make such an iniquitous bargain with this company. He had reason to think they were making what Parliament would consider an improvident bargain. He moved that that meeting be adjourned to Thursday at the Cannon Street Hotel, in order that they might further consider the matter.

Mr. King thought that, in consideration for the enterprise and indomitable perseverance displayed by the company in the early period of its history, before it was able to pay anything to its shareholders, they should be paid at par price for their property; that was to say, the whole of their capital, £338,000, should be paid to them.

The Chairman said a good many observations had been made under a misapprehension. Their rights expired on January 12th. Unless they had the right to land their cables they could not carry on their business. By arrangement they secured an extension of time up to March 31st. But the Government had informed him that they meant to grant no further extension; therefore the result of their refusal of the terms offered them would be that they would be left on April 1st with no business and with their cables at the bottom of the sea. Another point to be considered was that the English Government had undertaken to purchase their premises, which were fitted up as a central telegraphic station to carry on business with the Continent, by arbitration, and if they refused the offer for the cables in the absolute manner advised by one naturally impetuous shareholder he thought they would imperil all the rest of the arrangements. He could not agree with Mr. King's suggestion that they should ask for what they paid themselves years ago. The answer to that would be that they had for several years had upon their capital a very high rate of interest, which had recouped them for their big outlay. The reason why the sum offered was not stated in the notice of that meeting was that he had hoped in the interval between the issuing of the notice and the holding of the meeting to obtain a better offer. He could not see that any useful end would be served by an adjournment, whilst it might seriously imperil their property.

Both resolution and amendment having been seconded, the latter was put and negatived by a large majority, the Chairman's motion being then carried.

The Chairman moved that the directors should be authorised to pay out of the funds of the company the £300 necessary to make up the two years' salary of the retiring officers. This was seconded and carried unanimously.

Further resolutions were adopted empowering the directors to take such steps as were necessary for the voluntary winding up of the company, and appointing the Chairman, the Hon. H. R. Brand, and Mr. S. M. Clare, the secretary, liquidators.

A vote of thanks to the chairman and directors brought the proceedings to a close.

Direct Spanish Telegraph Company, Limited.

THE half-yearly ordinary general meeting of this company was held at Winchester House, Old Broad Street, on Monday, Sir James Anderson, Chairman of the company, presiding.

Mr. Ch. Gerhardi, the Secretary, having read the notice convening the meeting, and the minutes of the previous meeting having been confirmed,

The Chairman said: I have very little to say at this meeting. Curiously enough, I looked over what I said last year as I was sitting in the room three minutes ago, and to my no little surprise I had noted down the very same words to say again at this meeting. I said last year that we had carried 2,000 more messages in the three months than in the corresponding three months of last year, but that we had not earned so much money. I was going to say to you now that we have carried 2,000 more messages but 27,000 fewer words, the average length of a telegram having fallen by about three-fourths of a word. We are face to face with the natural desire of merchants to economise all they can, and to make telegrams as short as they can. I do not know how far they are going, or whether we shall first cry out. It is quite obvious that if they go on reducing the telegrams to only one word it will be almost impossible for us to pay anything. I find on investigation that there are an enormous number of our telegrams to the East consisting of only three or four words, and a three-word message does not pay at all. Whether anything will be done to alter that at the Conference I cannot say; but it is remarkable that whenever I come before you I have to say the same thing, that messages are getting shorter and shorter, and that we carry more, but do not get much more money. There is a decrease of £305, but that is not owing to the falling off in the traffic, but is attributable to the failure of the fruit trade. This year the fruit was as bad as it could be; it went rotten at sea. Formerly this would have been a more serious matter with us, because it was all fruit a few years ago; the telegrams were all about fruit and shipping, but now we have a more miscellaneous class of messages since the commercial treaty was framed. We cannot complain of our trade, which is a growing one, and a very sound one. You see by the report that we have had a break in our cable since the close of the half-year with which the report more particularly deals. Fortunately for this company the Eastern Telegraph Company had a ship at Lisbon, and that ship was able to get to the ground in three days from the time the cable broke, and though the weather was very bad she effected the repair in 16 days. Curiously enough that was exactly the time taken to repair the former break. I have a piece of the broken cable on the table. It was down in a thousand fathoms, and it was torn asunder by a landslip. You will see that six inches of copper are laid bare. Evidently a mountain of mud fell down and wrenched the cable in two. We cannot avoid these breaks; we have had them again and again, and cannot find any way of getting out of them except to repair. That repair has cost us £2,900; towards that £700 will come out of present revenue, so that we shall pay it partly out of revenue and partly out of reserve next year, unless, indeed, we have another break in which case I shall have something more to say at the next meeting. Notwithstanding that, and that the cable was broken for sixteen days, when we lost some of the traffic, but not all, for we have a joint purse arrangement with the Eastern Company, we have earned practically £250 more this quarter than we did in the corresponding period last year, which I think you will admit is very satisfactory indeed. I have nothing more to say, unless you ask some question to which I can reply. We are going on successfully, and Mr. Gerhardi and all our people are doing the best they can to increase the traffic, and at the present moment we are doing as well as we can very well expect. With these remarks I will move "that the report and accounts now presented be and are hereby received and adopted."

Mr. Edmund Etlinger seconded, and the resolution was carried unanimously.

The Chairman then moved "that a dividend at the rate of 10 per cent. per annum, less income-tax, on the preference shares, and a dividend at the rate of 4 per cent., free of income-tax, on the ordinary shares, both for the half-year ended December 31st, 1888, be and are hereby declared."

Mr. Etlinger seconded, and the motion was agreed to.

Sir James Anderson and Mr. J. D. Pender were re-elected directors, and the auditor, Mr. Herbert R. Duke, was also re-appointed; a vote of thanks to the chairman thereupon terminating the proceedings.

The Telephone Company of Ireland, Limited.

THE directors' report states that the total number of wires, exchange and private, under rental upon December 31st, 1888, was 970.

The Municipality of Cork having given permission to erect the requisite poles in the public thoroughfares, a telephone centre has been established in that city. As the exchange was only opened on January 1st last, the subscribers to the Cork centre are not included in the number of the company's subscribers stated in the previous paragraph as being under rental on December 31st, 1888. It will be satisfactory to the shareholders to be informed that the subscribers who had signed contracts before December 31st, 1888, for connection with the company's exchange, exceeded in number those to the local Post Office exchange, notwithstanding that the latter has been open for more than three years. A large accession to the number of the company's subscribers in Cork is confidently anticipated during the current year.

A trunk line, giving communication between Cork and Queenstown, has also been erected, and will shortly be opened.

Other trunk lines to the outlying districts of the City of Cork are in contemplation; some are in course of erection; and it is expected that the Cork system will shortly become one of considerable importance.

Encouraged by the success of the establishment of the exchange in Cork, the directors are now taking the requisite steps to extend the company's operations to Limerick. Permission for the erection of the poles in the thoroughfares has been given, and this work is now in hand.

It is also proposed to extend the company's system in other directions, so soon as the necessary permission and way leaves can be obtained.

Owing to the additional labour cast upon the board by the extension of the company's operations, it is proposed to fix the directors' fees from January 1st, 1889, at £300 per annum, and the fixed salary of the managing director at £250 per annum.

The amount standing to the credit of the net revenue account, including the balance of £366 1s. 5d. brought from last account, amounts to £4,643 17s. 8d., against £4,314 3s. 6d. for the year 1887. Out of this sum there has been paid an interim dividend upon the preference shares for the half-year ended June 30th, 1888 (£942 15s. 9d. paid in July last), also the interim dividend upon the ordinary shares (£875 0s. 0d. paid in August), leaving an available balance of £2,826 1s. 11d., as shown in the balance sheet, since reduced by payment (on January 14th), of the dividend upon the preference shares for the second half of the year to £1,837 5s. 9d., which the directors propose to allocate as follows:—For the payment of a dividend on the ordinary shares for the second half of the year, at the rate of 1¼ per cent. per annum (absorbing £1,093 15s.), equivalent to £1 2s. 6d. per cent. for the entire year, against 1 per cent. for the year 1887, and ¾ per cent. for the year 1886, and to place to the credit of the reserve fund £417 13s. 2d. (being 10 per cent. upon the net profits of the year), carrying forward the balance of £325 17s. 7d. to credit of the current year, as against £366 1s. 5d. brought on from 1886.

Eastern Telegraph Company, Limited.—The directors announce the payment, on April 15th, of a dividend of 3s. per share on the preference shares of the company, less income tax, for the quarter ending March 31st, and an interim dividend of 2s. 6d. per share on the ordinary shares of the company, free of income tax, in respect of profits for the quarter ended December 31st.

Eastern Extension, Australasia and China Telegraph Company, Limited.—The directors notify a further dividend of 2s. 6d. per share, together with a bonus of 3s. per share, making a total of 6¼ per cent. for the year 1888. The reserve fund has been increased by £66,101.

Humboldt Electric Power and Mining Company, Limited.—Certificates of shares in this company are now ready for delivery in exchange for the banker's receipts for payment of deposit, allotment and first call, at the offices of the company, 63 and 64, New Broad Street, E.C.

Globe Telegraph and Trust Company, Limited.—The directors have declared an interim dividend of 3s. per share for the current quarter, payable on the 18th prox.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 22nd, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £4,130.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts the week ended March 22nd, amounted to £4,670.

LEGAL.

Western Counties and South Wales Telephone Company, Limited, v. The Neath Harbour Commissioners.—Mr. Justice Wills, on Monday, delivered judgment at Bristol in this case, the action having been heard before him, without a jury, last week. Mr. Bompas, Q.C., and Mr. J. V. Austin appeared for the plaintiffs; Mr. Bucknill, Q.C., Mr. J. Alderson Foote, and Mr. R. H. Simonds for the defendants. The case raised a question of general importance as to the powers of harbour masters, acting under the provisions of the Harbours, Docks, and Piers Clauses Act, 1847. The plaintiffs' claim was for damages in respect of the removal and consequent destruction of a telephonic cable laid by them in the bed of the river Neath, near Briton Ferry, in Glamorgan, within the limits of the defendants' harbour. The dispute between the parties arose out of the fact that Lord Jersey is the lord of the manors of Neath and Briton, and claims to be entitled to the foreshores and bed of the river Neath. In October, 1886, the plaintiffs desired to lay a telephonic cable across the river Neath, and the defendants were prepared to give their permission for the laying of such cable, provided that the plaintiffs would enter into an agreement with them. Lord Jersey's agent, however, threatened that if the plaintiffs entered into any agreement with the defendants Lord Jersey would withdraw the wayleaves he had then granted for the purposes of the cable and wires. In the result, the plaintiffs laid the cable at a spot indicated by the defendants' harbour master, but without obtaining the defendants' consent. After much negotiation as to an agreement between the parties, the defendants' harbour master, alleging that the cable was an obstruction to navigation, cut the cable and dragged it out of the river, rendering it quite useless. Two points arose—first, whether the cable was in fact an obstruction to the navigation of the river Neath, and, secondly, whether, assuming it to be so, it was such an obstruction as the harbour master might summarily remove under the powers vested in him by sections 52 and 56 of the Harbours, Docks, and Piers Clauses Act, 1847. Evidence was given on behalf of the defendants that sailing vessels were in the habit of bringing up by casting anchor near the spot where the cable was laid, and that if a vessel's anchor fouled the cable she might be placed in a dangerous position, or might lose her anchor. The plaintiffs proved that telephonic cables existed in many similar channels without causing any danger, and they contended that, since no vessel had, in fact, been so obstructed, there was no evidence of any existing obstruction, at the time when the cable was cut; and, further, that the words of sections 52 and 56 of the Harbours, Docks, and Piers Clauses Act, 1847, which empower a harbour master to remove vessels, or wreck, or floating timber, or any other obstruction, do not empower a harbour master to remove in a summary way anything of so permanent and costly a nature as a telephonic cable.

His Lordship, in giving judgment, said the questions were whether the cable was really a source of danger, and, if so, was it an obstruction within the above-mentioned sections. It was immaterial with whose consent the cable was laid down, but the evidence was overwhelming that it was liable and likely to be a source of danger to ships anchoring near it, and in the way it was laid it was a real and substantial danger to ships using the harbour. On the correspondence he held that the defendants had never given leave to the plaintiffs to lay the cable where it was. The plaintiffs contended that by obstruction was meant a physical obstruction to the passage of vessels. If this were so, then ballast thrown so as to spoil the best anchorage ground would not be an obstruction, if it did not actually stop the passage of vessels. Good anchorage was part of a good harbour, and, in his opinion, obstruction to anchorage was within the Act, and the harbour master was therefore justified in removing the cable. He, therefore, gave judgment for the defendants with costs, but stayed execution for a fortnight. If notice of appeal be given within the fortnight, then execution to be further stayed pending the appeal.

IRON SHEATHING AND SPEED IN LONG CABLES.

Mr. A. E. Kennelly writes from the Edison Laboratory at Orange to the *Electrical World* as follows:—Having read with interest your editorial article in last week's issue upon "Iron or Hemp-covered Cables." and in which some doubt is expressed as to the certainty of the conclusions arrived at by Sir William Thomson regarding the effect of iron sheathing on the speed of signalling through long cables, I beg to submit to the consideration of your readers a fact which seems, as evidence upon this point, to have escaped consideration.

In the application of the duplex system to long submarine cables it is always admitted that the artificial line should be the exact representation of the actual cable in respect to resistance and electrostatic capacity, both singly and jointly considered. That this is, moreover, the true representation of the case is proved by the fact to which I can personally testify, that there is more than one case on record where the artificial lines having been made with great care as faithful copies of the cables for which they were prepared, were found on application to balance them for duplex immediately with little or no adjustment. Of course this is not the general experience, and much time is sometimes required to adjust an artificial line before balance is obtained, but this is always found to be due to imperfection in the imitation of the cable's resistance and capacity, and the principal must, on due examination, be admitted that a perfect artificial line would be a perfect counterpart of the resistance and capacity in the actual cable, both individually as well as in their mutual relationship. This is equivalent to the assertion that a long cable sheathed with iron may be balanced for duplex by an equally long imaginary cable of precisely similar core, but no iron sheathing. Hence it follows that there is no appreciable effect of electromagnetic induction, for if it existed, it is evident to anyone who has measured electro-magnetic induction, that in order to obtain balance between duplicate actual and artificial cables it would be necessary to insert a corresponding amount of electro-magnetic capacity in the latter, or what in this case would be an equivalent resource, to diminish the electrostatic capacity of the artificial line, particularly near its commencement. Hence the acknowledged coincidence in the proportions of resistance and capacity throughout the nearer sections of actual and artificial cables conclusively proves experimentally the results obtained mathematically by Thomson, Heaviside and Charles Hockin, to the effect that the iron sheathing of long cables has no depreciatory influence on their speed of transmission.

On the other hand, it is well known that very short cables worked at high speeds when balanced for duplex require less electrostatic capacity than a perfect imitation in their artificial line would demand, and this may perhaps be due to the effect of electro-magnetic capacity from the influence of their sheathings under those conditions of high speed and comparatively small retardation.

ON AN EFFECT OF LIGHT UPON MAGNETISM.[*]

By SHELFORD BIDWELL, M.A., F.R.S.

Several experimenters in the early part of the present century tried to magnetise iron and steel by the action of light,[†] but I do not know of any recent attempts in this direction, and of late years the thing has been generally regarded as impossible. Under ordinary circumstances there can be little doubt that this is the case, but, if a certain condition is fulfilled, we might, I think, expect to find some evidence of the action of radiation upon the magnetism of iron.

The condition is that the susceptibility of the bar, A, B, to be operated upon shall be greater (or less) for a magnetic force in the direction A, B, than for an equal one in the direction B, A. This paper contains a short preliminary account of a series of experiments which have been undertaken with iron bars having this property. Much yet remains to be done, which will require a considerable amount of time, and for which special apparatus must be constructed. In the meantime, the results already obtained appear to possess sufficient interest to justify their publication.

The method of preparing the bars is as follows:—A piece of soft iron rod, which may conveniently be 10 or 12 cm. long and from 0·5 to 1 cm. in diameter, is raised to a bright yellow heat and slowly cooled. When cold, it is placed inside a solenoid, through which is passed a battery current of sufficient strength to produce a field of about 350 or 400 C.G.S. units. The iron when removed from the coil is found to be permanently magnetised, and its north pole is marked for the sake of distinction with red sealing wax varnish. The bar is then supported horizontally and in an east and west direction behind a small reflecting magnetometer, and over it is slipped a coil, which is shunted with a rheostat, the resistance of which can be gradually increased from 0 to 26 ohms.

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[*] Paper read before the Royal Society, Thursday, March 21st.

[†] Chrystal, "Encycl. Britann.," vol. 15, p. 274, mentions the following names:—Morichini, Mrs. Somerville, Christie, Riess, and Moser.

The coil can be connected by a key with a single battery cell, which is so arranged as to produce a demagnetising force inside the coil. The resistance of the rheostat is slowly raised, so that more and more current passes through the coil, the battery key being alternately lifted and depressed until the magnetometer indicates that the iron bar as a whole is perfectly demagnetised. The strength of the demagnetising force required varies according to circumstances; it is generally about $\frac{1}{30}$th or $\frac{1}{35}$th of the original magnetising force.

After this treatment the iron rod does not differ, so far as ordinary tests will show, from one which has never been submitted to magnetic influences. Nevertheless, as is well known, it possesses certain properties which distinguish it from a piece of really virgin iron. In the first place, the magnetisation induced by a force acting in such a direction as to make the marked end a north pole, is greater than that caused by an equal force in an opposite direction. Again, if such a bar be held horizontally east and west (to avoid terrestrial influences), and tapped with a mallet, the marked end at once becomes a north pole. A similar effect follows if the rod be warmed in the flame of a spirit lamp. Lastly, if it be placed inside a coil and subjected to the action of a series of rather feeble magnetic forces, of equal strength but alternating in direction, the marked end will generally become a north pole, even though the last of the alternate forces may have tended to induce the opposite polarity.

A rod treated as above described appears to be remarkably sensitive to the action of light. When such a rod is placed behind the magnetometer, and illuminated by an oxyhydrogen lamp about 70 cm. distant, there occurs an immediate deflection of from 10 to 200 scale divisions,* the magnitude of the effect varying in different specimens of iron. As the action of the light is continued the deflection slowly increases. When the light is shut off, the magnetometer instantly goes back over a range equal to that of the first sudden deflection, then continues to move slowly in the backward direction towards zero.

The first quick movement I believe may be due to the direct action of radiation, and the subsequent slow movement to the gradually rising temperature of the bar. With a thick rod (1 cm. in diameter) the slow movement is barely perceptible, extending over only one or two scale divisions in the course of a minute, the spot of light becoming almost stationary after the first sudden jump. With a thin rod the sudden effect is generally smaller, while the slow after-effect is greater and may continue until the spot of light passes off the scale.

As a general rule the magnetic effect is such as to render the marked end of the rod a north pole; occasionally, however, it become a south pole, but in such cases I have always found that the polarity is comparatively feeble. It may even happen† that the marked end becomes north when certain portions of the rod are illuminated, and south when the light acts upon other portions. This is probably due to irregular annealing and a consequent local reversal of the direction of maximum susceptibility: it indicates that the light effect is local, and is confined to the illuminated surface. In one remarkable specimen, which happens not to have been annealed at all, the sudden effect and the slow effect are in opposite directions. When the light is turned upon this rod there is at first a sudden deflection of 20 magnetometer scale divisions to the left, the spot afterwards moving slowly and steadily towards the right. When the light is shut off there occurs at once a jump of 20 divisions further towards the right before the spot begins to move back in the zero direction.

Some attempts have been made to repeat the experiments with light polarised by means of a Nicol's prism; but, either because the largest prism at my disposal was too small (its aperture being barely 2 cm.), or because too much of the radiant energy was absorbed by the spar, I failed to get any magnetic effects whatever with the prism in either position.

[Prof. Silvanus Thompson has quite recently been kind enough to lend me a very large and excellent Nicol's prism. From a few experiments already made with this instrument it appears that the action of the light is quite independent of the plane of polarisation.—March 16th.]

There can be no doubt whatever of the reality of the effects here described; they are perfectly distinct, and are at any time reproducible with certainty. The only question is how much of them is primarily caused by the action of light, and how much by mere incidental change of temperature. But taking all the circumstances into consideration, I think the evidence is in favour of the conclusion that the *instantaneous* magnetic change, which occurs when a prepared iron bar is illuminated, is purely and directly an effect of radiation.

MUNICIPAL LIGHTING.‡

By F. H. WHIPPLE.

THERE are so many difficulties encountered in a proper consideration of the title of this paper that one does not embrace the suggestion to discourse upon it with enthusiasm. It is a subject seemingly rebellious to analysis, yet one that requires to be treated in language whose clearness is inexorable. In these times one writes and speaks to the multitude, and upon questions broad in their scope and far reaching in their effects, and ought never to shut himself up in any sort of Freemasonry of his own building. When an issue such as this presents itself to the electric light world for discussion it should be treated fairly and squarely, with intelligence and judgment, and without the heated arguments of business controversies.

"Municipal lighting," as generally considered, means the municipal ownership of the plant. I think this definition is erroneous, for the reason that the greater portion of the income of two-thirds of the electric companies of the country is derived from their public street lighting contracts. Of the total number of arc lights manufactured by private companies who are parties to a city contract, 68 per cent. are public lights, and are paid for by the municipalities. On the other hand, of the total number of arc lights upon the streets of the land, but one-third of one per cent. are owned and operated by municipalities. Therefore the logic of the subject is not confined entirely to the question of ownership. The issue, to my mind, is based as much upon the rental value of an arc lamp.

What is the rental value of an arc lamp? Statistics regarding the price paid by various cities are not lacking, but comparisons are worse than useless, for they seemingly go upon the principle that a light is a light, no matter what it lights, what it costs to produce it, whether it has good illuminating capacity, or whether the system be an inferior or superior one. The prices for light vary materially in different places, but I have been unable to see that they vary in accordance with any fixed relation to any other factors which would seem to have a bearing on the service. It may be truly said that nothing has an absolute value. It would be impossible to prove, on a general hypothesis, that fifty cents, or any other sum, is in any place the exact value of an arc light, but in this, as in all other cases, some price must be fixed.

In the staple articles of the world's production the law of supply and demand regulates prices, but as electric light companies, in their relations to city councils, act under influences individual in themselves, the case is very different. The price of light for commercial purposes is to some extent regulated by the fact that moderate prices materially increase the consumption, but in municipal lighting the city, if it accepts the terms offered, generally pays the contracted price. It is, therefore, in many, if not in most, cases a matter of comparative shrewdness of the officials on either side as to the price paid and the service rendered.

There are to-day in the United States 316 cities and towns whose streets are wholly or in part illuminated by electric lights furnished under a public contract. The highest price paid for an arc light of nominal 2,000 candle-power, burning all night, is $860; the lowest is $40. Between these two extremes there are 186 prices. Upon the moonlight schedule the maximum figure is $165; the minimum $50.

What makes these wide differences in price? Granted, that in many places local conditions, excessive competition, or the absence of all competition have weight in determining the cost of production, what reason shall we give for the varying figures exhibited in a wide field of localities where the conditions are almost absolutely identical?

The average cost of all night public lighting in the United States to-day is $121 per light; for schedule lighting $110. In 1885 the cost was on an average $167 per light for all night lighting, and $135 for schedule lighting. In 1886 it was $160 and $125. In 1887 it was $130 and $117. In 1888 it was $129 and $114. Thus we find that the price of public lighting has been steadily decreasing for several years, and to a large extent within the past few months. Contracts that have been renewed since the last meeting of this association in September show a net reduction upon all night lighting of 23 per cent., and upon schedule lighting of 19 per cent. The general run has been from 15 to 33 per cent.; but there are several cases reported where the reduction has exceeded 50 per cent. An increased contract price is rare, less than a dozen in the country so reporting, and the highest figure reached is 20 per cent., while the lowest is 8 per cent.

These statistics do not furnish any guide as to the rental value of an arc lamp. The price paid by one city is often twice as much as that paid by a neighbouring city, yet one would scarcely wish to be quoted as saying that the cost of production was in the same relative proportion. It is obviously worth more to produce a light in one place than in another, but is it worth twice as much? It will no doubt be said that different degrees of illuminating candle-power enter into the problem, but in my computations I have considered none but nominal 2,000 candle-power lights. Sometimes the area lighted is pushed forward in explanation, but this has no connection, that I can see, with the cost of the light itself.

There is really no basis fixed upon which to charge for public lighting, nor any general data by which a fair rate may be arrived at. I am, therefore, of the opinion that coincident with the discussion of ownership, should come that relating to the value of the light, for this is really the primal cause for so much agitation of municipal control.

When it comes to the question of ownership there are three parties in interest, the parent companies who manufacture the material to be used, the local companies that have invested their capital in a business they have the natural right to make as lucrative as possible, and the public, represented in an intermediate capacity by municipal councils. Accordingly we find three separate and distinct views taken of the question, and we are forced to believe that all three are right from their standpoint. Of the three factors, the local companies are the only ones presenting a solid front. They are united in the expression that municipalities ought not to do their own lighting. In view of the constant decrease in the price of electric lighting previously shown, and the transitory periods of electrical machinery, the local companies are mechanically correct in their claim to be able to generate electricity as cheaply as a municipality. Many of the circumstances, by reason of which the sentiment favourable to municipal ownership became prominent, do not have force to-day. The new and improved formulæ and the cheapening processes of production private companies are able to take advantage of where municipalities would not. Compound and condensing engines have made it possible to reduce the cost of power; more light is produced from a less expenditure of energy; carbons have fallen from $50 and $60 to $8 and $10; it is no longer necessary to locate a station in the central and therefore the most expensive portion of a city, and more attention is being given to water-power. All these are contributory to the claim of the private companies that municipalities should not enter into an investment the extent of which they are ignorant of in the face of a declining market.

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* The magnetometer mirror was 1 mètre distant from the scale and each division = 0·64 mm. ($\frac{1}{40}$th inch).

† This has been observed in two specimens.

‡ Paper read at the convention of the National Electric Light Association at Chicago.

With the parent companies the effects of municipal ownership are just beginning to be appreciated. There is no doubt but these organisations will at no distant day be brought squarely to face the alternative of refusing to sell material to municipalities altogether or of going out of business. It has been their custom while acknowledging an unwritten obligation to protect their local companies, to consider that they are not bound by any special dispensation to refuse a sale when the opportunity presented itself. They are not prepared to say that it is inadvisable for a city to operate its own plant as long as the city already has the other fellow's system installed. When it comes to a city which has a private plant of this or that particular system, then this or that particular parent company is decidedly opposed to the city embarking in the business.

For these truly natural characteristics, capital is quickly bringing the parent companies to a halt. No company is large enough or financially strong enough to organise and operate the local companies necessary for the times. Therefore it is local capital and local activity that is the mainstay of the parent companies. Capital is always nervous, and we can readily see that with the continued growth of a sentiment favourable to cities doing their own lighting, capital will not run any risks. It will not invest in a city or town where a community interest stares it in the face.

There is another reason why the municipal ownership of plants does not run parallel with the interest of manufacturing companies. In the case of the municipality the net result of a year's operation is public property, while it is to the interest of private corporations to keep within their own knowledge the actual outlays. A larger increase in the amount of goods required may also be expected from them than from municipalities. And from the exasperating incidents of carrying through a municipal deal, with its attendant train of demoralising influences, every company would fain be freed. I do not believe there is a parent company in the country that has made money by selling plants to municipalities. I know some who have lost money, and I wonder that as a whole they are not ready to commit themselves unqualifiedly and negatively upon the subject of municipal ownership. The time is near when they will be forced to go upon record in this matter, but to-day they are vacillating and uncertain. They believe that in some cases it would be a manifest advantage for cities to own their plant, and in other cases just as manifest a disadvantage. They would like to have each case stand independently.

In considering this subject from the standpoint of the public servant, it becomes at once a question of advisability, to which is naturally attached, although seldom considered, the element of responsibility. The theory of the political economist is that the monopolies of service should be owned by the municipality, and all belong to the community. In European countries this idea is carried to a much further extent than in our own. In many English speaking communities the public service does not stop with light, water and transit, but municipal ownership often extends to the bath, the laundry and the bakery.

It has been more gradual in America, doubtless because the tendency of the times in all municipal governments is toward political aggrandisement, and that it inevitably leads to corruption and a debauchery of the public service. It has, therefore, become necessary to largely restrict the functions of the local governments by more general legislative bodies. In America politics is the national characteristic, and the ordinary politician is only theoretically honest. He recognises moral turpitude only to the extent of dreading exposure of his own backalidings, while, if he break the law, he nevertheless outwardly insists on the sanctity of the law. Municipal service can be, and ought to be, administered with quite as much freedom from corruption as when in the hands of private parties. But in few instances do we find it so administered. We are thus confronted with a condition, not a theory, and in the municipal ownership of electric light plants this condition is easy of demonstration. I believe I can truthfully say that the experience of city governments in this line has not been in all respects satisfactory. Starting out a year ago as the investigator for a large municipality, I have closely studied the workings of almost every city plant, and, with but one or two exceptions, I would not now commend their operation. The officials of the smaller towns where municipal plants have been installed, with an amount of crude ignorance of the subject that is truly appalling, do not hesitate to assert that they and the people are well satisfied with the experiment; but in the majority of cases these officials are in office largely through the machinations of rings, and it would not be in the line of policy for them to decry the schemes of their associates.

The illumination of towns by themselves is on the intermittent plan of lighting, the hours varying so that no basis for comparison can be arrived at. The average advocate misinforms the investigator by holding up to view the proposition that these cities are doing their lighting for a merely nominal cost, while his figures are really superficial and not entitled to support. They are figured on isolated conditions to suit the emergency, often with items charged to other departments for the sake of a plausible showing in the lighting account. On one occasion, where I was called upon to estimate the cost of all night service for a large city, upon its merits, my figures were $92 per year, with interest and depreciation, and that I think is not very far from the cost of an arc lamp in our average communities.

A strong claim is made that, despite the prejudicial influence of politics that enter into their management, municipal stations have reduced the cost of public lighting in their localities over the contract system.

I have previously stated that the average present price of public lighting in the United States is $121 per arc lamp per year, burning all night, and $110 per lamp burning on schedule. The average cost to municipalities which are furnishing their own light is $76 for an all-night light, and $44 for what they term a schedule light. This schedule is deceptive, and does not provide for as many hours' lighting as the usual contract does. Therefore the latter suffers by comparison. It is often the case, also, that the light is furnished in connection with some other department which bears a portion of the interest and depreciation account. Free water power and sometimes so-called free attendance also enters into these figures and distorts them.

The only argument worthy of consideration in favour of municipalities doing their own lighting is that of cheapness, and emphasizes what I have said in a previous part of this paper, that an important question involved is the rental value of an arc lamp.

Municipalities have not yet succeeded in reducing the price of light abnormally below the average. I do not consider the fact of any weight that a city, by reason of its not being compelled to pay taxes, and because it has no profit to make, can manufacture light cheaper than a private company, for I expect that what it saves in this way will be counterbalanced by losses caused by the influences of its management.

Here arises the question of a personal financial responsibility. We have become accustomed to consider that all public business, being in a sense, everybody's, is really nobody's, and too often it is the case that a mere perfunctory public duty is performed for the sole sake of the salary attached to the office. Any business enterprise to be conducted successfully ought to be carried on by men who are financially interested in it, and who feel in their own pocket the cost of every expenditure. A city government cannot possibly take that view of it, even though its departments were paved with good intentions.

There is but one view, and that a conditional one, in which municipal ownership can be indorsed. If the expenses of the plant can be kept within reasonable bounds, if the management is in all respects such as you would commit your own private business to, if there are no outside prejudicial influences, then, from the standpoint of the public servant, it would be desirable for some cities to do their own lighting. Without these qualifications it would be inadvisable.

The price of public lighting has outstripped all other questions in the financial management of our cities. It has become, if not the chief source of expense, the greatest bone of contention, and the electric light companies that will observe the handwriting on the wall, and meet the subject half way, will do much to dissipate this sentiment antagonistic to their interests. There is room for improvement in public lighting. Contracts are not made by people living in a millenium, but by the mingled good and bad as they are found in the business world and municipal councils, and as they probably will be found for some time to come. There are several sides to this as to all questions, and there is a happy medium. In this medium the electric light fraternity should clasp bands with the well meaning and observant public servant, and see to it that while fair profits are returned for the service rendered, a union of interest is formed, cordial in its nature, though commercial in its results, and there will then be no occasion for public sentiment manifesting itself in the municipal ownership of electric light plants.

THE MASSACHUSETTS LEGISLATURE AND ELECTRIC RAILWAY WIRES IN BOSTON.*

THE street railway committee of the Massachusetts Legislature has been carrying on a hearing relative to the measure granting permission to the West End Railway Company, of Boston, and others, to run overhead electric railway conductors through the streets of Boston and other Massachusetts cities. A large number of persons interested in street railways, together with a number of prominent electricians and others interested in the subject, were present at the meetings and took part in the discussion, which was confined principally to the question of danger to life and property.

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* The *Electrical World*.

Hon. F. O. Prince appeared for the remonstrants, and said that if the overhead system was a necessity they must submit, but he believed it was not a necessity, inasmuch as there were other systems, such as the storage battery and underground conduit, which are entirely practical. He characterised the overhead wires as unsightly and dangerous to life and property, and considered it unwise, in the present experimental state of electrical knowledge, to enact a general law allowing companies to use electricity in this objectionable and dangerous manner at the option of boards of aldermen and selectmen.

Mr. William Bracken, President of the Julien Electric Company of New York, said that the time had not come when the practicability of overhead lines was demonstrated, and that they were unsightly and an element of danger. Mr. Bracken challenged the West End Railway Company, or any other company, to tell at the present time what it cost to run a car by electricity. They were, however, going to gridiron the city with wires before they knew whether the system was practical or not, and without any knowledge of what is being done toward perfecting the operations of electric street railways, without the objections due to overhead conductors. Mr. Bracken then spoke of the general demand for burying the present overhead wires in the principal cities of Europe and America, wires that are absolutely safe in comparison with those required for the operation of electric railways, and which do not offer nearly so great an obstruction, despite their number, as would the overhead electric railway wires and the supports required for them. Mr. Bracken further declared that the conduit system or the secondary battery must finally be adopted. With regard to the alleged failure of the conduit system in Boston, Mr. Bracken said that the conduit was doing a thousand times better than the overhead system was doing a year ago, and that forthcoming improvements would place it far ahead of the overhead system for city use. He also went on to speak at length of the advantages of the storage battery system, and stated that his own company had four cars in regular service on the Fourth Avenue and Madison Avenue line in New York, where they are giving excellent satisfaction, and that he was prepared to place a car upon the West End Company's line for the purpose of demonstrating its superiority over the overhead system.

An affidavit was then read from Mr. Elias E. Ries, of the Ries electric railway system, of Baltimore, which was listened to with more than ordinary interest, setting forth some of the principal objections against the use of overhead conductors for electric railways in cities, and stating that their introduction would tend to retard the burial of the present overhead wires. Mr. Ries further stated that it was too early to decide that the overhead system is the only practical form for cities, that it was not objectionable for suburban roads, but that the conduit system or the secondary battery would eventually be adopted in crowded cities. He also said that many prominent inventors and electricians are at work on systems of electrical traction that are specially applicable to city traffic, and not open to the objections incident to the use of overhead conductors.

An affidavit was also read from Dr. P. H. Vander Weyde, in which particular stress was laid upon the danger of the bare overhead wires being struck by lightning, and the committee subsequently listened to the remonstrance of the North American Insurance Company, who stated that the overhead wires, owing to their unprotected nature, are an ever probable cause of fire by reason of telephone wires falling upon them, and that the wires are furthermore a hindrance to the fire department as they prevent the putting up of ladders, and the wires used, as on the Cambridge electric railway, are so thick that they cannot be cut by the shears used by the fire department.

Mr. Ries, who was present at the meeting, was asked in reference to the danger attending the employment of overhead electric railway wires. He stated that numerous cases have occurred, and are likely to again occur, where persons have received severe shocks, and in some instances, sustained permanent injuries from currents such as used on the Boston electric railways, and that under certain conditions it was possible for persons to receive a fatal shock from an electric railway circuit carrying current at an electromotive force of 500 volts, which is the pressure said to be used on these lines. The danger from this cause is increased, Mr. Ries said, when the track rails or ground are used as the return conductor, as is the case in nearly all of the overhead conductor electric railways so far put in operation. When a large number of cars are to be operated it will be necessary either to increase the potential of the current or to run supplementary main and feeding conductors of large carrying capacity, both of which are objectionable, and especially so if these conductors are carried overhead.

Prof. Elihu Thomson, of the Thomson-Houston Electric Company was called as an expert in behalf of the West End Railway Company. He maintained that the voltage used on the Boston railways (500 volts) was perfectly harmless, and stated that he did not know of a fatal shock ever having been received on any of the electric railway lines in this country. He said that in New York the Western Union Telegraph Company have used a pressure of 400 volts on their telegraph lines for the past fifteen years, and that no harm has come from it. To prevent accidental contact with telephone and other conductors his company proposed to run guard wires above the electric railway conductors, and to obviate the use of too large an overhead conductor on lines having a heavy traffic, he would increase the number of power stations along the line of railway, or run underground feeding conductors of sufficient size to carry the current to the overhead wires. With regard to the danger from fire, he stated that instead of being an objection the overhead wires would prove an advantage, since the current furnished by them might be used to operate electrical fire engines to put out fires. On cross-examination by Mr. Ries, Prof. Thomson admitted that the railway current might burn out and set fire to an unprotected telephone instrument in case of a "cross" between the telephone line and the railway wire, and that it was possible for a person to receive a very severe, though not fatal, shock from a 500-volt current. Prof. Thomson further admitted that a practicable underground conduit system was less objectionable than the overhead system for city use, and stated that he would be one of the first to welcome such a conduit, but that he did not then know of any conduit that would answer the requirements.

A somewhat lively discussion took place between Prof. Thomson and Mr. Bracken during Wednesday's session, in which the latter charged Prof. Thomson with trying to influence the minds of the committee by making certain statements relative to the alleged safety of very high tension currents, which the Professor said he had taken without injury, and in withholding information whereby the degree of danger might be determined. It was brought out that an electromotive force of 10,000 volts could be taken with safety from an induction coil in which the current generated was so small that it amounted to but a very small fraction of one ampère, but that in the operation of electric railways the current may reach several ampères, and that the amount of current that can be received by a person is only limited by his resistance as compared with that of the motors on the line, which resistance differs in different persons.

Mr. C. J. H. Woodbury, Captain Griffin, and others also spoke in behalf of the Thomson-Houston and West End companies. Several witnesses were produced who testified to receiving more or less severe shocks from the overhead conductors, the potential and current strength of which, however, they were unable to state, and they showed by their presence that they were still "alive and kicking." The committee adjourned before the testimony was concluded, and will listen to further arguments upon a date to be appointed by them. Several interesting developments may be looked for, as the bill, if passed, will be likely to re-open the entire overhead wire question.

NEW PATENTS—1889.

3761. "Improvements in electric tubes and fuzes for firing ordnance and exploding torpedoes and mines, and for like purposes." H. C. L. Holden. Dated March 4.

3808. "Improvements in electric signals for engine shafts." J. C. Ricketson. Dated March 5. (*Complete.*)

3813. "Improvements in telephonic switching apparatus." A. R. Bennett. Dated March 5. (*Complete.*)

3835. "A new or improved incandescent electric lamp." E. Bohm. Dated March 5.

3836. "Improvements in electric arc lamps." L. Hanson. Dated March 5.

3844. "Improvements in or relating to regulators for systems of electrical distribution." W. P. Thompson. (Communicated by the Westinghouse Electric Company, United States.) Dated March 5.

3870. "Improvements in electric motors and dynamo-electric machines." H. H. Lake. (Communicated by O. Lugo, United States.) Dated March 5. (*Complete.*)

3881. "Improvements in the method of and apparatus for regulating electric currents." J. W. Balet. Dated March 5. (*Complete.*)

3907. "Improvements in electrical switches." T, Parker and E. S. G. Rees. Dated March 6.

3922. "Improvements in the methods of suspending electric or other lights, applicable to other purposes." H. C. Harold, R. Jenkins and S. Johnson. Dated March 6.

3940. "Improvements in galvanic batteries." G. A. Schoth. Dated March 6.

3967. "Improvements in arc electric lamps." T. Robinson. Dated March 6.

3971. "Improved compound or admixture of ingredients suitable for producing electric energy." J. J. Rathbone. Dated March 6.

4004. "Improvements in electric apparatus which may be combined with mechanical apparatus for the transmission of sound, the combined apparatus may also be applied to other useful purposes." R. H. Courtenay. Dated March 7.

4029. "Improvements in the distribution of electric energy." G. Wilkinson. Dated March 7.

4049. "Improvements relating to electric lamps." W. F. Smith and J. Sinclair. Dated March 8.

4171. "Improvements in accumulators or secondary batteries." W. L. Wise. (Communicated by F. C. Glaser, Germany.) Dated March 9.

4192. "A new or improved regulator for transformed electric currents." Siemens Bros. & Co., Limited. (Communicated by A. M. Taylor, India.) Dated March 9.

4208. "The automatic regulation of E.M.F. or current in dynamo machines." H. T. Harris and A. Gay. Dated March 11.

4250. "Improvements in apparatus for attaching and suspending electric lamps." J. E. Spagnoletti and J. Crookes. Dated March 11.

4287. "Improvement in instruments for measuring electric currents." J. W. King. Dated March 12.

4296. "Improvement in galvanic batteries." J. Kynoch. Dated March 12.

4336. "Improvements in electrical switches." T. Spencer. (Communicated by H. T. Paiste, United States.) Dated March 12. (*Complete.*)

4371. "Improvements in electricity meters, parts of such improvements being applicable to electrical clocks and other electrical instruments." G. Hookham. Dated March 13.

4407. "Improved method of and means for code signalling with electric telegraphs." H. E. M. D. C. Upton. Dated March 13.

4448. "Improvements in or pertaining to incandescent electric lamps." F. E. Elmore. Dated March 14.

4484. "Improvements in electric distribution." W. M. Mordey. Dated March 14.

4508. "Improvements in apparatus for electrically regulating the 'drag' on the fibres during the operation of spinning and twisting." G. Shackleton. Dated March 15.

4519. "Improvements in electric cranes and hoists." W. Hartnell. Dated March 15.

4530. "Improvements in coin-freed apparatus for obtaining a current of electricity during definite periods of time for producing electric light, and for other purposes." H. S. Price and H. J. Dowsing. Dated March 15.

4547. "A combined wind indicator and lightning conductor." J. Booth and J. Thompson. Dated March 15.

4559. "Improvements in voltaic batteries." D. G. Fitzgerald. Dated March 15.

4566. "An improved method of distributing electricity for lighting purposes." W. L. Preece and J. Sayers. Dated March 15.

4569. "Improvements in metallic telegraph poles." W. F. Dennis. Dated March 15.

4586. "An electric light switch." A. Milton, H. W. Bishop, and F. Brown. Dated March 16.

4588. "A portable electric alarm clock." S. Naylor. Dated March 16.

4599. "Electrolytical process and apparatus for producing bleaching powder and other materials." C. Lever. Dated March 16.

4623. "An improved metal reflector for electric search lights used in ships of war." J. Farquharson. Dated March 16.

4642. "Improvements in apparatus for measuring and registering the consumption of electric energy." E. A. G. Street. Dated March 16.

4654. "Improvements in meters for electricity." J. Cauderay. Dated March 16. (*Complete.*)

4656. "Improvements in electric signal apparatus." H. Thomlinson. Dated March 16.

4657. "Improvements in electrical weighing machines." J. M. Napier. Dated March 16.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1888.

1707. "Process for recovering zinc and alkali from spent liquors of Lalande voltaic batteries." H. A. Fergusson. Dated February 4. 6d. Claim:—The described process for recovering zinc and alkali from spent liquor of Lalande batteries, by subjecting the liquor to electrolytic action in thin layers between iron plates and zinc, or amalgamated plates, filter pressing the mixture of liquor and deposited zinc, returning the pressed out liquid to the electrolytic bath for further action and forming the zinc into blocks or ingots by pressure or fusion.

2772. "Improvements in electrical safety appliances." Killingworth W. Hedges. Dated February 24. 8d. Relates to the protection of transformers or induction coils, and consists principally in connecting the secondary circuit to an electrode fixed in a tube or receiver made of glass or other suitable insulating material, the tube containing rarefied gas. Another electrode is also fixed in the tube and connected to earth. Or on either side of the tube a fuse wire is placed, which, on melting, may be made to establish a connection between the poles of the primary circuit, with the object of short circuiting them, and thus causing the main fuse or cutout on the primary circuit to melt. The claims are 4 in number.

2785. "Improvements in holders for electric glow lamps." E. F. H. H. Lauckert. Dated February 24. 8d. Consists mainly in carrying the helical supporting spring for the lamp upon a bracket so arranged that the bottom of the spring is thereby raised some distance above the insulating base of the holder, so as to leave a clear space below it, and thus allow the small contact springs to which the loops of the glow lamp are hooked to be easily reached. The claims are three in number.

2794. "Improvements in electrical firing keys or contact makers." C. A. McEvoy. Dated February 24 8d. Claims: 1. The construction of electrical firing keys, or contact makers, with a pistol handle, and with the front end portion capable of turning on a hinge joint and with two insulated conductors passed through the front end portion to two metallic plates at its rear end, and with a flexible waterproof diaphragm in rear of the two plates carrying a small metallic disc, which can be pressed against the two plates and made to form an electrical connection between them. 2. The construction of electrical firing keys or contact makers, with a spring safety bolt for locking the trigger, and a spring bolt to hold the safety bolt out of action when it has been withdrawn, and which, when the trigger is pulled, is itself pressed back and made to release the safety bolt so that the safety bolt again locks the trigger when it returns to its backward position. 3. The construction of electrical firing keys, or contact makers, substantially as described and illustrated in the drawing.

2933. "Improvements in mechanism for regulating the force of dynamos or magneto-electric generators." H. J. Haddan. (A communication from abroad by W. S. Hill, of Boston.) Dated February 27. 8d. Relates to a novel mechanism adapted to be used in connection with a dynamo or magneto-electric generator to regulate the force of the current taken therefrom in order that it may be kept as nearly uniform as possible; and it relates particularly to that class of regulators in which the brushes of the commutators are mounted loosely upon the axis thereof, and are adapted to be automatically shifted toward or from the neutral points of the commutators as the amount of work required of the machine is varied. The claims are 6 in number.

3223. "Improvements in secondary batteries." W. Kingsland. Dated March 2. 6d. The inventor employs a negative element or anode consisting wholly or mainly of peroxide of lead in a hard, dense, compressed or agglomerate condition, and not in contact with any oxidisable metal, and in conjunction with this element he employs a positive element or cathode of zinc, and he prepares this zinc element so as to resist "local action" by first amalgamating it with mercury, and then depositing on it electrolytically a coating of zinc, or he may deposit the zinc on some other metal, such for instance as lead. The claims are 2 in number.

8700. "Improvements in and relating to electric batteries." L. M. J. C. C. Renard. Dated June 13. 8d. Claims:—1. In galvanic or electric batteries, the employment of chlorochromic exciting liquids, prepared as described, in combination with silver electrodes, platinised on both surfaces by lamination, and with the electrodes and cells arranged and constructed, substantially as shown and described. 2. In galvanic or electric batteries, the employment of chlorochromic exciting liquids, prepared substantially as described. 3. In galvanic or electric batteries, the employment of positive electrodes consisting of a sheet of silver platinised on both sides by lamination.

8950. "Improvements in applying electrical traction to pleasure, sporting, and business purposes." C. B. Burdon. Dated June 19. 6d. The invention has for its object the propulsion of horses of wood, metal or other material, cars or vehicles of any shape, also of wood, metal or other material, mainly for purposes of amusement by means of electricity running free on tracks of any size, shape or configuration, such horses, cars or vehicles to be steered in any direction as required. In carrying the invention into practice the inventor causes to be constructed a wooden or other track or course of suitable width, length and form. On the surface of this track or course he causes to be laid strips of metal, preferably copper, of suitable width, to convey the electric current. He leaves sufficient space between each strip to prevent what is known as short circuiting, and he connects each strip alternately with the positive and negative poles of a dynamo machine. The horse, cars or vehicles run over this track or course on wheels geared to an electro-motor carried in or upon such horses, cars or vehicles. The electric current is conveyed along the strips of metal from the dynamo to the motor preferably by wire brushes. By varying the distance of these brushes apart it becomes more or less difficult for the rider or passenger to steer so as to keep the horse, car or vehicle on opposite strips at one and the same time; he controls the speed of the said horses, cars or vehicles by the insertion of variable resistances. The claims are 3 in number.

CORRESPONDENCE.

The Problems and Conditions of Ocean Telegraphy.

In your issue of February 22nd, you were kind enough to quote from my letter which appeared in the New York *Electrical World* of February 2nd. As your comments on the paragraph in my letter on "work already accomplished" are misleading, I ask you, in all fairness, to give me space in your next issue to insert the full statement, so that your readers may see that it was not my intention to prove the possibility of laying a hemp-sheathed cable of our type in deep water, for the question of laying or of recovering a cable of this description has never been considered by us a matter of doubt.

The New York *Electrical World* of January 26th states:—

"It would, indeed, be a great change if our ocean cables were of the type he describes with a greatly increased capacity for speed in working." To which I said:—

"Although for obvious reasons we have not written on this subject—we have quietly worked on, knowing the inevitable must come, when the merits of the type of cable we advocate are fully known. It is now some four years since we entertained high hopes that with our patent deep-sea type of cable we should not only get greater durability, but that we should also get a considerable increase of speed. *The work we have already accomplished fully confirms the anticipations we then entertained, and gives us greater hope for the future.*"

As to the "durability" of hempen material when properly treated, that question has long since been settled by competent judges.

Your remarks on grappling are based on old and crude methods, in fact, the "rough and ready work" described in the *Journal of the Society of Telegraph-Engineers*, Vol. XII., page 535. In our work we neither submit our grapnels or cables to such "rough treatment," in proof of which I may state that we have lost but one grapnel and broken only two during five years of hard work in all depths, from 20 fathoms to 2,700 fathoms, and on all kinds of bottom. The one we have now in use has been worked several years, and is good for many more. This form of grapnel is fully described in the above-mentioned Journal.

Let me now refer you to the statement in the last paragraph of my letter in which I said that our patent deep-sea cable was—

"Constructed of non-oxidisable and non-magnetic materials with all the strength required for water of the greatest depths, *even including the Pacific Ocean with its* 4,500 *fathoms*," and your remarks thereon. Believe me, Mr. Editor, I am too serious in this matter to state anything which can be construed into a "bugbear . . . . held up to frighten naughty people who advocate a Pacific cable." In your issue of February 15th you admit a depth of over 4,000 fathoms, so why quibble over a paltry 500?

Before closing I must call your attention to the paper "On deep-sea soundings in relation to submarine cables," read by Mr. Wm. Lant Carpenter, B.A., B.Sc., on November 8th, 1888, before the Society of Telegraph-Engineers, see Vol. XVII., pages 664 and 665, in which he states:—

"The work of the United States steamer *Tuscarora* (Commander George E. Belknap), however, deserves special notice here, because she was sent out by the United States Government, not with a view to scientific research, but for the purpose of determining by deep-sea sounding the most practicable route for a cable between the Pacific seaboard of the United States and Japan . . . . Here such great depth of water—over 4,600 fathoms—was met with, having a bottom temperature of 32°, that it was then deemed (1874) an impracticable route for a cable."

In the discussion on the same paper, Captain W. J. L. Wharton, R.N., F.R.S., said:—

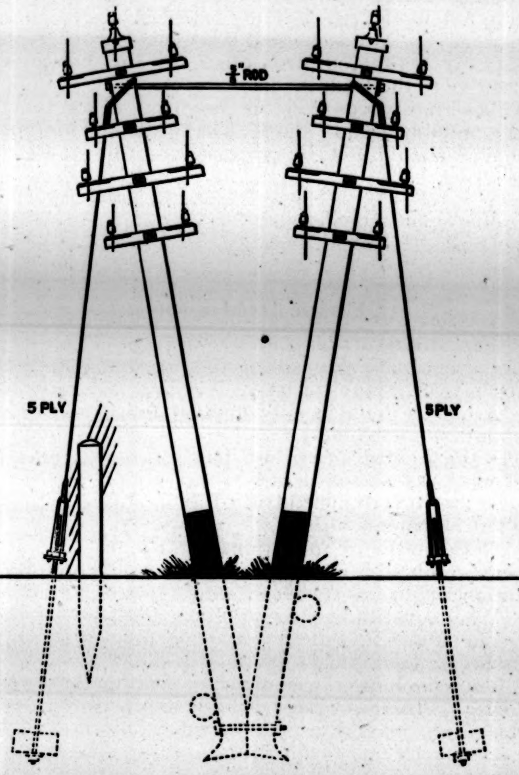
"I may mention that I have this last week received a letter from one of our surveying vessels in the South Pacific, from Captain Aldrich, of the *Egeria*, where he has obtained a very deep sounding of 4,430 fathoms south of the Friendly Islands."

Samuel Trott.

Halifax, Nova Scotia, *March 7th*, 1889.

New Design of Duplex Telegraph Pole.

The enclosed sketch is an idea that struck me the other night after reading, in the REVIEW of the 15th ult., that Mr. Gilbert's improved pole had come to grief near Inverness.



You will observe that the arrangement is reversed, the object being to reduce the height of the poles, and consequently add to their stability. If such an idea is novel, perhaps you, Sirs, or your scientific readers will enlighten me as to the defects, if any, that may exist.

Subscriber.

The Properties of Lead.

As there seems to be considerable difference of opinion about the use of lead as a covering for electric light cables, I think that perhaps a few notes on the properties of the above metal may prove useful. Compared with other metals, lead possesses neither ductility nor tenacity. When exposed to the air it soon tarnishes, but the film of oxide so formed protects the metal from further action. If, however, the metal is exposed to the combined action of pure water and air, it is powerfully and continuously corroded. This action is hastened in the presence of ammonia and certain salts, such as the chlorides and nitrates, and diminished in the presence of sulphates, phosphates and carbonates. Certain vegetable matter has also been found to act as a preservative.

Probably the most powerful enemy of lead is acetic acid, and it is known in the manufacture of white lead that a small quantity of the vapour of this acid in the presence of air will convert a very large amount of lead into the carbonate.

Sulphuric and hydrochloric acids have no action on lead in the cold, and only a slight one when heated. The alkalis do not have any appreciable effect. Paraffin oil has considerable action and is capable of absorbing a large amount of lead, in so much that if the oil is stored in leaden vessels it is quite spoilt for illuminating purposes.

Looking at all these facts, it appears that a covering of lead would prove a doubtful protection for a cable unless the condition of the soil where the cable had to be laid were exactly known beforehand.

In clay soils it would be simply a question of time for the lead to be eaten away, but in a light sandy soil the cable might last for an indefinite period. It has been frequently suggested to add to the lead a certain percentage of tin; this plan would, no doubt, render corrosion less likely, but the alloy would be more brittle and expensive. You suggested last week that by laying the lead covered cable in iron pipes, the iron being electro-positive to the lead, the latter would be thus preserved. This certainly would be the case if the electrolyte were, say, sulphuric acid; but if it happened to be an organic acid, I should not be surprised to find the polarity reversed.

R. Frederick Yorke.

March 25*th*, 1889.

Electric Traction Patents.

The editors of *La Lumière Electrique* have drawn my attention to the passage in your last issue respecting myself. May I ask—

Are not patents usually applied for in the hope of obtaining a monopoly?

If the granting of a patent does not confer a monopoly, of what use is the patent?

Is the Government justified in accepting the fees for granting patents unless they are valid?

In the event of inventions for which patents have been granted proving to be invalid through prior publication, ought not the Government fees to be returned?

What constitutes prior publication?

The above questions are of general interest, and might be discussed in your columns.

The concluding statement in your notice is hardly logical. If the "Experienced Engineer" had abandoned the inventions in question there would be no necessity for me to apply for an injunction to restrain him from using. It seems that the gentleman in question, who could not spare time to discuss the matter with me when approached in a friendly spirit, is able to give you the information I desired. I offered the olive branch; that being refused, I throw down the glove. I am determined to test my patents, for it is no use continuing to pay taxes thereon if they do not grant me a monopoly.

M. Holroyd Smith.

Paris, *March* 25*th*, 1889.

[Patents appear to us to be granted for new inventions or improvements upon old ones, and not, as has so often been the case, as a means for levying blackmail from other workers in any given field which has not been legally held to be covered by such master patents as the incandescent lamp or telephone transmitter of Edison. Whether the Government is justified in taking fees for ostensibly protecting ideas which have been previously patented does not need discussion here; but if Mr. Smith's patents were taken out before the new Act, he knows as well as we do that in those days, at least, no searches were made to show anticipation, except by the inventor himself or his patent agents. Still, it is not for us to dictate what Mr. Smith should or should not do; no doubt his opponents are quite able to take care of themselves. The whole matter appears to us too trivial to go to law about, and so waste money which could be better spent in developing rather than retarding the spread of electrical traction, for no man, however much he may be interested in adapting electrical energy to tramcar propulsion, cares to enter into negotiations with a pending lawsuit hanging over his head. We cannot, however, credit Mr. Smith with entertaining jealous or hostile feelings towards other tramway men, because his sole object appears to be to test the validity of his own patents rather than to show that there exists any infringements of his assumed rights; but surely a less expensive and equally certain method of procedure might have been adopted.—EDS. ELEC. REV.]

Hotel Lighting.

Please correct a statement made in your last issue.

The entire work for the lighting of the Lime S Hotel, Liverpool, has been carried out by the telegr staff of the London & North Western Railway Co pany, under my charge and the supervision of t Company's Telegraph Engineer.

What the Liverpool Electric Supply Comp has done is to supply the current by means accumulators which are fixed in the basement of t station buildings and charged from one of its cen stations.

Geo. Edwin Fletcher, *Stud. Inst. C.E., A.I.E.E.*

March 28*th*, 1889.

Telephone Patents.

Our attention has been called to a paragraph in yo edition of the 15th instant, headed "Telephones— Protest," and we think that if the Stanhope Comp will do us the favour of reading our statement ag it will be clear to them—at least, on reflection—that w refer to telephones under recognised patents, viz., the held—and successfully held—by the United Telepho Company, from whom we hold the sole licence t supply for use by that company in the United Kingdo and also the sole licence to manufacture in this countr for export.

W. J. M. Menzies.

THE CONSOLIDATED TELEPHONE CONSTRUCTIO
AND MAINTENANCE COMPANY, LIMITED.

March 25*th*, 1889.

Dynamo Designing.

Would you kindly explain the working of the fo mula in Prof. Jamieson's paper on the designing o dynamos, viz.:—

$$K_{La} = \frac{E_a}{T_{aw} \times N_{ar} \times 10^{-6}} = \frac{107\cdot6}{240 \times 800 \times 10^{-6}}$$

$$= 530 \text{ lines of magnetism.}$$

And would you kindly let me know (approximately) how far I should be wrong in designing by the fo mulæ given in the above paper.

A Student.

March 19*th*, 1889.

[If our correspondent reads the paper again he wil understand, we think, the meaning of the formul which seems clear enough. The objection to it lies in the fact that the Kapp units chosen are the most brain-bewildering of inventions, and accordingly we give the formula in C.G.S. units. An E.M.F. of 1 volt is pro-duced by a conductor cutting 10^8 C.G.S. lines of forc per second. Each conductor on the outside of Gramme ring cuts 2 N lines of force per revolution if is the total number of lines passing between the pole If n is the revolutions per second, the lines cut by each conductor per second $= 2\,N\,n$, and since the con-ductors in the ring are in two parallels we have for th E.M.F., $E = \frac{N\,n\,W}{10^8}$ where W is the number of wir counted all round the outside and $N = \frac{E\,10^8}{n\,W}$. As re-gards the second question we have already given exa formulæ for obtaining the induction through the arma-ture in our articles on "A Synthetic Study of Dyna Machines," to which we must refer our correspondent. —EDS. ELEC. REV.]

IN our answer to "Tyne" in last week's Corre spondence the expression "zinc or + current" shoul read "copper or + current."—EDS. ELEC. REV.